

Original Research Article

Predicting the need for ventilatory support in organophosphorous compound poisoning

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Received: 06 October 2018

Accepted: 29 October 2018

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ABSTRACT

Background: Organophosphorus compound poisoning is one of the most common poisonings often requiring ICU care and ventilatory support. Hence this study was undertaken to identify the factors, which predict the need for ventilation in these patients.

Methods: All the patients who were diagnosed to have consumed organophosphorus compound poison admitted in RLJ Hospital and SNR District Hospital Kolar, Karnataka, India who presented within 24hours of consumption were included in the study. Patients with concomitant respiratory illness, double poisoning and those treated outside were excluded from the study.

Results: A total number of 50 patients were studied. 30(60%) were males and 20 (40%) were females. 18 patients required ventilation. 100% of patients with respiratory rate >25 breaths/minute and 55% of patients with a fasciculation score of >4 required ventilation. Ventilation was required by 84.6% of patients who has a GCS Score of <10. 21.7% of patients with mild and 33.3% with moderate poisoning required ventilation. In contrast 66.6% of patients with severe poisoning required ventilation. Of the patients admitted to the hospital >4hours after consumption of poison, 36% required ventilation. Of the 19 patients who had oxygen saturation levels <89%, 18 patients (94.7%) required ventilation. Patients who were ventilated required a higher dose of atropine within 48hours of admission as compared to those who were not ventilated.

Conclusions: Patients who presented with higher respiratory rate, accessory muscles of respiration in action, higher fasciculation score, GCS score of 10, greater lag time between consumption of poison and admission to hospital (4hours), severe grade of poisoning and O₂ saturation <89% were more likely to require ventilation. There is no relationship between the age group, sex, pulse rate, pupil size and type of organophosphorous compound consumed with the need for ventilation.

Keywords: Organophosphorous compound poisoning, Atropine, Oxygen saturation, GCS score

INTRODUCTION

Organophosphorous compound poisoning is a major health problem not only in developing countries but also in western countries.¹ Hospital based statistics suggest that nearly half of the admissions to emergency with acute poisoning are due to Organophosphorous compound poisoning.² Organophosphorous compounds poisoning affects globally approximately 3 million

population and causes 2,00,000 deaths annually, most of these occur in developing countries.³

Nearly 90% of the poisoning are suicidal with a fatality rate of >10%. 8-10% accidental and <1% Homicidal. Occupational exposure accounts for 1/5th of accidental poisoning with fatalities of <1%. Suicide is the major cause of poisoning in developing countries.⁴

The biological effects of organophosphorous compound are as a result of accumulation of endogenous acetylcholine at sites of cholinergic transmission. Most organophosphorous compounds are readily absorbed through respiratory, oral mucous membrane, GIT mucous and through intact skin, as they are lipid soluble. This binding is irreversible, except with early pharmacological intervention.⁵

The diagnosis is based on the history of exposure and features of cholinergic overactivity.⁶ The treatment includes atropine or glycopyrrolate, which acts as a physiological antidote, PAM which help in reactivating the enzyme. Complications like respiratory failure, CNS depression and ventricular arrhythmias should be anticipated and treated.

The early causes of death in organophosphorous compound poisonings are chiefly related to ventricular arrhythmias, CNS depression, seizures or respiratory failure due to excessive bronchial secretions, bronchospasm, pulmonary edema, aspiration of gastric contents, paralysis of respiratory muscles or apnea associated with depression of the medullary respiratory center.⁷ Late mortality is associated with respiratory failure.^{8,9} And infections like pneumonia, septicemia or complications related to mechanical ventilator and intensive care management.¹⁰ As a treatment modality for this complication ventilator is required.

This study will help us to identify the factors, which help in predicting the need for ventilatory support in a patient with consumption of organophosphorous compound.

METHODS

The study was conducted on 50 patients who were diagnosed to have consumed organophosphorous compound poison admitted in R. L. Jalappa Hospital and Sri Narasimha Raja District Hospital who were admitted within 24 hours of consumption of the poison over a period of 1 year.

The included patients were intensively monitored for signs of respiratory insufficiencies like respiratory rate of >30 breaths/minute, accessory muscles of respiration in action, O₂ saturation <90%, Arterial Blood Gas Analysis (ABG)- PaO₂ <50mmHg, PCO₂>50mmHg. If any one or more are present, the decision for mechanical ventilator was taken. Bradycardia was defined as <60beats/minute.

Patients with concomitant illness or conditions likely to alter the respiratory effort due to organophosphorous compound poisoning, patients with double poisoning with other poisons, those with chronic lung disease and those treated outside were excluded from the study.

Based on the factors that influence the need for ventilatory support, the severity of organophosphorous

compound poisoning was graded as mild, moderate and severe poisoning. Mild Poisoning includes

- Normal level of consciousness (score of 12-15 by Glasgow coma scale (GCS)).
- Pupil size \geq 4mm.
- Fasciculation score 0-1.

Moderate Poisoning includes

- Mild alteration in level of consciousness (score of 8-11 by GCS).
- Pupil size 2-3mm.
- Fasciculation score 2-4.

Severe poisoning includes

- Stupor/Coma (score of 7 or less by GCS).
- Pin point pupil (1mm or less)
- Presence of convulsions
- Fasciculation score 5 or more.
- Signs of respiratory insufficiency.

Statistical methods

Chi-square test and Fisher Exact test has been used to find the significance of ventilation requirement for all the study parameters. The Odds ratio has been used to find the strength of relationship between the ventilation requirement and the each study parameters. Analysis of variance has been used to find the significance change of study parameters in mild, moderate and severe type of poisoning. The Kruskal walis test has been used to find the significance change of GCS-score in mild, moderate and severe type of patients, as the GCS-score do not follow normal distribution. Student t test has been used to find the significance of mean difference atropine within 48hours between ventilated and not ventilated patients.

The Statistical software namely SPSS 10.0 and Systat 8.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

Around 50 patients diagnosed to have consumed organophosphorous compound poison were studied in relationship to the need for ventilatory support. In the total target study of 50 patients, 18 patients required ventilatory support.

As shown in Table 1, majority of the patients who were ventilated were in the age group of 21-30 (58%) but this was not statistically significant (P>0.05).

As shown in Table 2, male patients were 30 (60%) and females were 20 (40%). The gender distribution among patients ventilated is not statistically significant with sex (P>0.05).

Table 1: Age distribution with ventilation.

Age in years (n=50)	Number of patients presented	Number of patients with ventilation	P value	Odds Ratio (Ventilation)
13-20	11 (22%)	4 (8%)	P>0.05	1.02
21-30	29 (58%)	11 (22%)	0.738	1.22
>30	10 (20%)	3 (6%)	0.730	0.71

Table 2: Sex distribution with ventilation.

Sex	Number of patients presented (n=50)	Number of patients with ventilation (n=18)	P value
Male	30 (60%)	13 (26%)	P=0.186
Female	20 (40%)	5 (10%)	

Table 3: Relationship of compounds consumed with ventilation.

Compounds (n=50)	Number of patients presented	Number of patients with ventilation	P value	Odds Ratio (Ventilation)
Betanechol	4 (8%)	-	-	-
Chlorpyrifos	(2%)	-	-	-
Cypermethrine	1 (2%)	-	-	-
Diazinon	1 (2%)	-	-	-
Dimethoate	13 (26%)	7 (14%)	0.180	2.75
MetaDimethoateid	1 (2%)	1 (2%)	0.360	-
Methyl parathion	13 (26%)	7 (14%)	0.180	2.75
Monocrophos	8 (16%)	2 (4%)	0.694	0.54
Quinophos	2 (4%)	-	-	-
Triazophos	5 (10%)	1 (2%)	0.642	0.40
Volphor	1 (2%)	-	-	-

Table 4: Relationship of fasciculation score with ventilation.

Fasciculation score (n=50)	Number of patients presented	Number of patients with ventilation	P value	Odds ratio (ventilation)
0	14 (28%)	3 (6%)	0.181	0.38
1-3	20 (40%)	5 (10%)	0.186	0.44
≥4	16 (32%)	10 (20%)	0.007**	5.42

** highly statistically significant

Table 5: Relationship of pupil size with ventilation.

Pupil size (n=50)	Number of patients presented	Number of patients with ventilation	P value	Odds ratio (ventilation)
≤1	24 (28%)	10 (20%)	0.423	1.61
≥2	26 (52%)	8 (16%)	0.423	0.62

As shown in Table 3, of the patients who consumed organophosphorous poison, dimethoate and methyl parathion were the most commonly consumed poisons (13 in each group). 54% patients who consumed these compounds required ventilatory support. Patients who consumed monocrophos and triazophos were least likely to receive ventilatory support. Hence, statistically patients

who consumed dimethoate and methyl parathion are 2.75 times more likely to receive ventilation.

As shown in Table 4, generalised fasciculations was another conspicuous feature in 72% of cases in this study. Patients with fasciculation score of ≤3 are less likely to

receive ventilation. The patients with a fasciculation score ≥ 4 are 5.42 times more likely to receive ventilation.

As shown in Table 5, patients with pupil size ≤ 1 mm are 1.61 times more likely to require ventilation as compared to the patients with pupil size ≥ 2 mm. This finding is not statistically significant.

As shown in Table 6, thirty seven (74%) patients had a GCS- score of 11-15, out of these 7(18.9%) patients required ventilatory support. Ventilatory support was required by 84.6% of patients who had a GCS score ≤ 10 . Hence, patients with GCS-score ≤ 10 are 23.57 times more likely to receive ventilation when compared to the patients with GCS-score 11-15.

Table 6: Relationship of GCS-score with ventilation.

GCS-score (n=50)	Number of patients presented	Number of patients with ventilation	P value	Odds ratio (ventilation)
≤ 10	13 (26%)	11 (22%)	$P < 0.001^{**}$	23.57
11-15	37 (74%)	7 (14%)	$P < 0.001^{**}$	0.04

Table 7: Requirement of ventilatory support in relation to severity of organophosphorous compound poisoning.

Type of poisoning (n=50)	Number of patients presented	Number of patients with ventilation	P value	Odds ratio (ventilation)
Mild	23 (46%)	5 (10%)	0.050*	0.30
Moderate	15 (30%)	5 (10%)	0.797	0.85
Severe	12 (24%)	8 (16%)	0.01*	5.60

Table 8: Relationship between time lag of consumption of poison and admission to the hospital with ventilatory support.

Pulse rate (n=50) Beats/mins	Number of patients presented	Number of patients with ventilation	Significance (p value)
≤ 60	3 (6%)	1 (2%)	$P > 0.05$
61-70	31 (62%)	13 (26%)	0.264
≥ 71	16 (32%)	4 (8%)	0.266

Table 9: Relationship of pulse rate with ventilation.

Pulse rate (n=50) Beats/mins	Number of patients presented	Number of patients with ventilation	Significance (p value)
≤ 60	3 (6%)	1 (2%)	$P > 0.05$
61-70	31 (62%)	13 (26%)	0.264
≥ 71	16 (32%)	4 (8%)	0.266

Table 10: Relationship of respiratory rate with ventilation.

Respiratory rate (n=50) breaths/min	Number of patients presented	Number of patients with ventilation	P value	Odds Ratio (Ventilation)
≤ 20	30 (60%)	3 (6%)	$P < 0.001^{**}$	0.04
21-25	8 (16%)	3 (6%)	$P > 0.05$	1.08
26-30	9 (18%)	9 (18%)	$P < 0.001^{**}$	-
> 30	3 (6%)	3 (6%)	0.042*	-

As shown in Table 7, five (21.7%) of the patients with mild poisoning and 33.3% of the patients with moderate poisoning required ventilatory support. In contrast 66.6% of the patients with severe poisoning required ventilation. Hence, patients with severe poisoning were 5.6 times more likely to receive ventilation.

As shown in Table 8, of the patients admitted to the hospital 4 hours after consumption of poison, 36% required ventilatory support. In comparison, patients admitted < 4 hours of consumption did not require ventilatory support. This finding is statistically significant.

As shown in Table 9, bradycardia was present in 6% of the cases in the present study. There is no statistical association between pulse rate and ventilation.

As shown in Table 10, 100% of the patients with respiratory rate >25breaths/minute required ventilatory support, which is statistically significant with a P value <0.001.

Table 11: Relationship of O₂ saturation with ventilation.

O ₂ saturation (n=50)	Number of patients presented	Number of patients with ventilation
90-100%	31 (62%)	-
≤ 89%	19 (38%)	18 (36%)

As shown in Table 11, of the 19 patients who had oxygen saturation levels of ≤89%, (94.73%) required ventilatory support.

Table 12: Relationship of the use of accessory muscles with ventilatory support.

Accessory Muscles	Number of patients presented	Number of patients with ventilation
Not-acting	32 (64%)	-
In action	18 (36%)	18 (36%)

As shown in Table 12, eighteen (38%) patients had accessory muscles of respiration in action, of which all required ventilatory support. This is statistically significant.

Table 13: Relationship of atropine dose within 48hours of admission with ventilatory support.

	Atropine dose(mg) within 48 hrs	
	Number of patients	Mean±SD
Ventilated	18	161.33±64.31
Not ventilated	32	100.93±93.12
Significance Student t	Student t=3.971, P=0.00239**	

As shown in Table 13, patients who were ventilated required a higher dose of atropine within 48hours of admission as compared to those who were not ventilated. This is statistically significant.

DISCUSSION

Acute Organophosphorous compound poisoning is one of the most frequent poisonings encountered in RLJH. The major cause of poisoning in the present study was

attempted suicides (100%). Suicide is the major cause of poisoning in developing countries.^{4,8}

In contrast, figures from developed countries like Japan, show accidental exposure forms a major bulk of organophosphorous compound poisoning cases.⁶

Among the 50 cases studied, majorities of the patients were in the age group of 21-30 years (58%). This correlates with the study done by Singh S et al.¹¹

In the present study, 60% of the patients were males. This correlates with the findings of the previous studies. However, in a study done by Vishwanathan M et al.¹² 66% of the patients who consumed organophosphorous compound were females.

Vomiting was the most common symptom in 80% of the patients in this study. This correlates with the studies done by Gupta OP et al.¹³ Singh S et al, Goel et al, where vomiting was present in 90% and 97.08% of the cases respectively.^{11,14} Vomiting was probably due to chemical gastritis.

Generalized fasciculations was another conspicuous feature in 72% of cases in this study. Whereas, studies done by Goel et al and Sarjit Singh et al, showed that 55% and 100% of the patients respectively had fasciculations.^{14,11}

Twenty four (28%) patients had pupil size ≤1mm of which 10 (41.6%) patients required ventilatory support. According to the study done by OP Gupta et al.¹³ 28% had pupil size ≤1mm who required ventilatory support. In comparison, in a study done by Robert et al, 73% who had pupil size ≤1mm required ventilation.¹⁵

Bradycardia at admission was present in 6% of the cases in the present study. In comparison, in a study done by Robert et al.¹⁵ 19% of the patients had bradycardia, while in a study carried out by Nouria S, 17% had bradycardia.¹⁶ This has not been compared with the need for ventilation. Twelve (24%) patients had respiratory rate >25breaths/min of which all patients required ventilatory support. The higher respiratory rate was probably due to increased secretion and more severe respiratory paralysis caused by the poison itself. According to the study done by Mutalik GS et al.¹⁷ 40% of the patients had a respiratory rate more than 30 breaths/min but this has not been compared with the need for ventilation.

Nineteen (38%) patients had oxygen saturation levels of ≤89% out of which 18 (94.73%) patients required ventilatory support. Eighteen (36%) patients had accessory muscles of respiration in action, of which, all required ventilation. There are no comparative studies available.

It was observed in this study that 36% of the patient with respiratory failure required mechanical ventilation as compared to 40% of the patients in a study done by Tsao TC et al.⁶ Arterial blood gas analysis was done in 18 patients who had a respiratory rate >25 breaths/minute and whose accessory muscles of respiration were in action. All of them had respiratory acidosis.

Patients who were ventilated required a higher dose of atropine within 48 hours of admission as compared to those who were not ventilated. This was consistent with the findings of the study done by Goel et al.¹⁴ Higher dose of atropine may indirectly indicate the severity of poisoning which might have caused respiratory paralysis requiring ventilation.

The severity of organophosphorous compound poisoning and the need for ventilatory support was studied in relationship to the nature of compounds consumed. 53.64% of the patients who consumed dimethoate and 53.64% of the patients who consumed methyl parathion required ventilation in this study. Whereas, in the study done by Goel et al.¹⁴ 66.67% of the cases who had consumed Dimethoate was associated with maximum need for ventilatory support.

Ventilatory support was required by 84.6% of patients who had a GCS score level of less than 10. This correlates very well with the study done by Goel et al, where 84% of the patients with GCS- score less than 10 required ventilation.¹⁴

Of the patients with fasciculation score ≥ 4 required ventilatory support in our study whereas in a study done by Goel et al, 55% of the patients with a fasciculation score of more than or equal to 4 required ventilatory support.¹⁴

Around 21.7% of the patients with mild poisoning and 33.3% of the patients with moderate poisoning required ventilatory support. In contrast 66.6% of the patients with severe poisoning required ventilation. Studies done by Goel et al, have shown that about 4% of the patients with mild and 6% of patients with moderate poisoning required ventilator support whereas 62% of the patients with severe poisoning required ventilatory support.¹⁴ The reason for greater percentage of patients requiring ventilation in mild poisoning group in our study is likely to be due to the greater time lag between poison consumption and to admission at the hospital. This in turn resulted in delay in treatment, like initiation of gastric lavage and administration of atropine and PAM.

Of the patients who were admitted to the hospital after 4 hours or more, after consumption of organophosphorous poison, 36% required ventilator support, as compared to those who were admitted within <4 hours of consumption. The studies done by Goel et al, and Kumar SS et al which indicated a very significant relationship between delay in treatment and need for ventilator

support.^{14,18} In contrast, a study done by Karnik et al, found this delay statistically insignificant.¹⁹

CONCLUSION

The factors, which predicted the need for ventilatory support in organophosphorous compounds poisoning in our study of 50 patients, were as follows:

The presence of higher fasciculation score (≥ 4) was associated with the higher need for ventilatory support. A GCS score ≤ 10 was significantly associated with an increased need of ventilatory support. Greater time lag between consumption of poison and admission to hospital (≥ 4 hours) was associated with higher need for ventilator support. Higher respiratory rate (>25 breaths/minute) and accessory muscles of respiration in action was significantly associated with higher need for ventilator support. O₂ saturation of ≤ 89 mmHg was significantly associated with higher need for ventilatory support. Grade 3 severity of poisoning was associated with higher need for ventilator support. Dose of atropine greater than 150 mg within 48 hours of admission was associated with higher need for ventilatory support.

The relationship between age group and sex with ventilatory support was not found to be significant. Size of the pupil and pulse rate, type of organophosphorous compound consumed had no relevance in predicting the need for ventilatory support.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Philip SM. Predicting the need for ventilatory support in organophosphorous compound poisoning. *Int J Res Med Sci* 2018;6:4015-21.