



Predictive Factors for Ventilatory Support in Organophosphorous Poisoning

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Abstract

Background and Objectives: *The leading cause of death in Organophosphorus poisoning is respiratory failure, which results from a combination of respiratory muscle weakness, central respiratory depression, increased bronchial secretions, bronchospasm and pulmonary edema. A substantial number of deaths can be prevented with timely institution of ventilator support. The present study was undertaken to identify the factors, which help in predicting the need for ventilator support and monitoring in the ICU.*

Materials and Methods: *124 consecutive patients of Organophosphorus poisoning admitted to Government medical college, Kottayam, for a period of 10 months were studied. Patients were selected irrespective of age or sex. A provisional diagnosis of Organophosphorus poisoning was made on the basis of a definite history of Organophosphorus poisoning by patient or attenders. This was substantiated by examination of the container, when available. The diagnosis was further substantiated by typical clinical features (hypersalivation, miosis and fasciculations) and characteristic odor of stomach wash or vomitus.*

Results: *Of 124 patients, 44 required assisted ventilation. The need for ventilator support was significantly more with greater time duration of institution of specific treatment, low level of sensorium at admission, pin point pupils, generalized fasciculations, presence of convulsions and presence of respiratory insufficiency at admission.*

Conclusion: *The ventilator support in organophosphorus poisoning patients decreases the mortality secondary to organophosphorus related respiratory failure*

Keywords: *Organophosphorous, Ventilator support.*

Introduction

Organophosphorous compound poisoning is a major health problem not only in developing countries but also in western countries¹¹. Hospital based statistics suggest that nearly half of the admissions to emergency with acute poisoning are due to organophosphorous compounds.¹²

Organophosphorous compounds are easily available as insecticides in shops and have resulted

in a gradual increase in suicidal and accidental poisoning. Nearly 90% of 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%.¹³

OP compounds inhibit Acetylcholine esterase (Ache) which hydrolyses Acetyl choline (Ach). The inhibition of cholinesterase activity leads to

the accumulation of Ach at synapses, causing overstimulation and subsequent disruption of transmission in both the CNS and the Peripheral Nervous Systems (PNS). Exposure to OP compounds will, therefore, interfere with synaptic transmission peripherally at muscarinic neuroeffector junctions and nicotinic receptors within sympathetic ganglia and at skeletal NMJs.¹⁶ Diagnosis of the cholinergic syndrome in most instances is based on history of exposure to or intake of an OP compound along with clinical features.¹⁷ The treatment includes atropine or glycopyrrolate which acts as a physiological antidote. PAM which help in reactivating the enzyme. Complications like respiratory failure, CNS depressions & ventricular arrhythmias should be anticipated and treated.

The early causes of death in organophosphorous compound poisoning are chiefly related to ventricular arrhythmias, CNS depression, seizures or respiratory failure due to excessive bronchial secretions, bronchospasm, pulmonary oedema, aspiration of gastric contents, paralysis of respiratory muscles or apnoea associated with disruption of medullary respiratory center.¹⁴ Late mortality is associated with respiratory failure and infections like pneumonia, septicemia or complications related to mechanical ventilator¹⁵. 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 patients with consumption of organophosphorous compounds.

Objectives

To study the factors which help in predicting the need for ventilator support in patients admitted in medical ward and ICU.

Materials and Methods

Type of study: A descriptive study

Period of study: 10 months

Study setting: Department of General Medicine, Govt. Medical College, Kottayam.

Study Population: Patients admitted in medicine ward and ICU following organophosphorous poisoning.

Inclusion Criteria

Patients who have consumed organophosphorous compound poison and being admitted within 24hrs of consumption.

Exclusion Criteria

1. Patients with concomitant illness or conditions those are likely to alter the respiratory effort due to poisoning.
2. Patients who consumed other poisons along with organophosphorous compounds.
3. Patients with chronic lung disease and
4. Patients treated outside for the poisoning are all excluded from the study.

Sample Size

$$N = (Z\alpha)^2 pq/d^2$$

$Z\alpha = 1.96$ for α at 5% level of significance

$P =$ prevalence of ventilatory support in patients with OP poisoning - 48% (Rajeev H, Arvind M N, Study of clinical and biochemical parameters in predicting the need for ventilatory support in organophosphorous poisoning)

$$q = 100 - p$$

$d =$ absolute precision (9)

$$(4 \times 48 \times 52) / 9 \times 9 = 123$$

Minimum required sample size - 123

Study Tools

1. History and clinical examination.

Methods

After obtaining permission and approval from institutional review board, 123 patients satisfying the inclusion criteria were included in the study. A provisional diagnosis of OP poisoning was made on the basis of definite history of poisoning either by the patient himself or from attendants, which was substantiated by (a) examination of the container, and or (b) typical clinical features (hyper salivation, vomiting, urinary incontinence, miosis and fasciculation), and or (c) characteristic odor of stomach wash and or vomitus. Detailed clinical examination including general examination and systemic examination with

special reference to level of consciousness, pupil size, SPO₂ at the time of admission was done. Investigations like ABG analysis was done to assess respiratory insufficiency. The patients included in the study were intensively monitored for any signs of respiratory insufficiency like respiratory rate of >30 breaths/minute, accessory muscles of respiration in action, O₂ saturation <90% and Arterial Blood Gas Analysis showing PaO₂ <50 mmHg or PCO₂ >50 mmHg. If any one or more present decision for mechanical ventilation is taken. A bolus dose of atropine was administered till signs of atropinisation (dryness of mucosa, pupillary dilatation, heart rate >100/min). Dose of atropine required in first 48hrs was thus estimated.

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 includes⁵

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

Moderate poisoning includes

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

Severe poisoning includes

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

Grading of fasciculation was done by giving 1 point depending on the presence of fasciculation each to the anterior chest, posterior chest, anterior abdomen, posterior abdomen, right thigh, left thigh, right leg, left leg, right arm and left arm. The total fasciculation score was thus estimated.

The need for ventilatory support with respect to each of the above clinical parameters was then

assessed and their significance of association was correlated with the biochemical investigations.

Data Entry and Analysis

The data was entered in Microsoft excel and further statistical analysis was done using SPSS 16 software. Chi-square test and Fischer Exact test was used to find the significance of ventilatory requirement for all study parameters. Independent t test was used to compare quantitative variables. The Odds ratio was used to find the strength of relationship between ventilatory requirement and each study parameter. A p-value of <0.05 was considered statistically significant.

Results and Observation

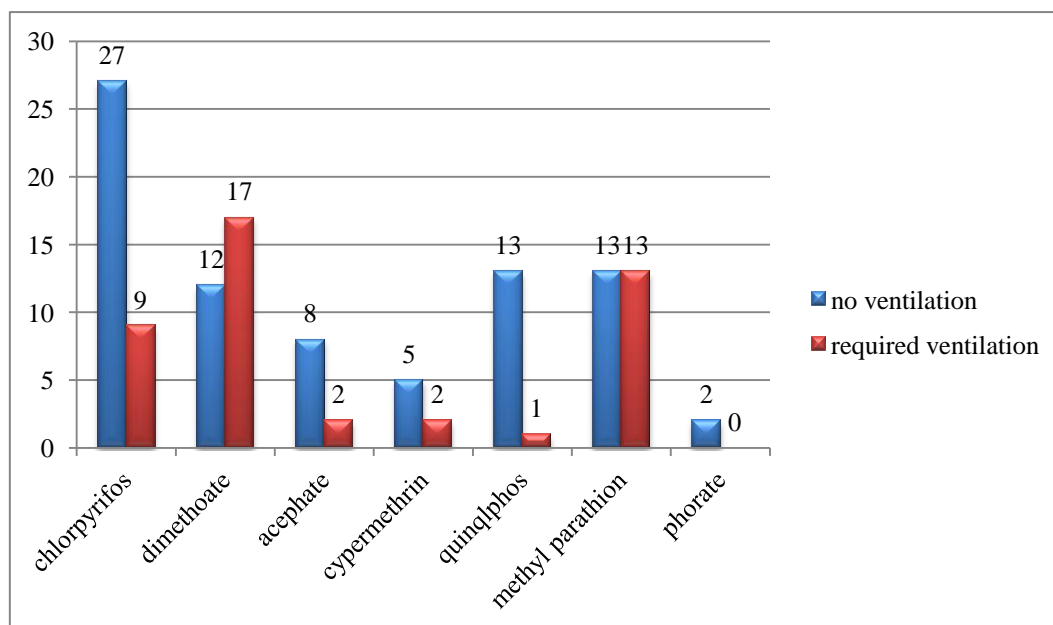
124 patients diagnosed to have consumed organophosphorous compound poison were studied in relationship to the need for ventilatory support. In the total target study of 124 patients, 44 patients required ventilatory support.

Table1: Age distribution with ventilation

Age group	Required ventilation		Total
	No	Yes	
16-25	19	12	31
	61.3%	38.7%	25%
26-35	36	12	48
	75.0%	25.0%	38.7%
36-45	18	10	28
	64.3%	35.7%	22.6%
46-55	4	7	11
	36.4%	63.6%	8.9%
56-65	2	3	5
	40.0%	60.0%	4.0%
66-75	1	0	1
	100.0%	.0%	0.8%

Table 2: Relationship of Compounds consumed with ventilation

Compounds consumed	Required ventilation		Total
	No	Yes	
Chlorpyrifos	27	9	36
	75.0%	25.0%	29%
Dimethoate	12	17	29
	41.4%	58.6%	23.4%
Acephate	8	2	10
	80.0%	20.0%	8%
Cypermethrin	5	2	7
	71.4%	28.6%	5.6%
Quinalphos	13	1	14
	92.9%	7.1%	11.3%
Methyl parathion	13	13	26
	50.0%	50.0%	21%
phorate	2	0	2
	100.0%	.0%	1.6%

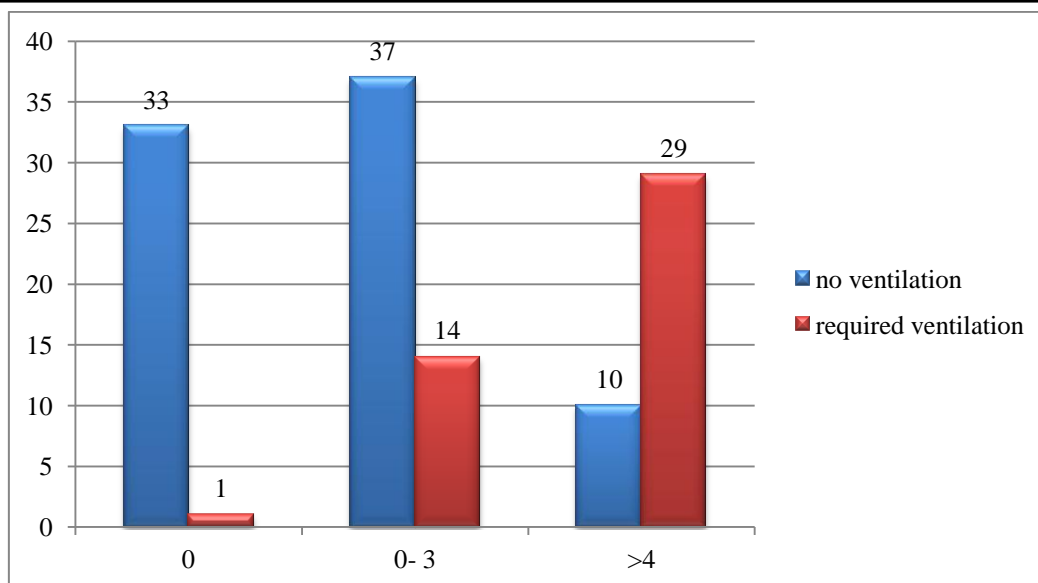


Graph 2: Relationship of Compounds consumed with ventilation

Of the patients who consumed organophosphorous poison, chlorpyrifos (29%) and dimethoate (23.4%) were the most commonly consumed poisons. 58.6% patients who consumed dimethoate required ventilatory support. Patients who consumed phorate and quinalphos were least likely to receive ventilatory support. Hence, statistically patients who consumed dimethoate (58.6%) and methyl parathion (50%) were more likely to receive ventilation. (p<.0006)

Table 3: Relationship of fasciculation score with ventilation

Fasciculation score	Ventilation required		Total
	No	Yes	
0	33	1	34
	97.1%	2.9%	27.4%
1-3	37	14	51
	72.5%	27.5%	41.1%
≥ 4	10	29	39
	25.6%	74.4%	31.5%

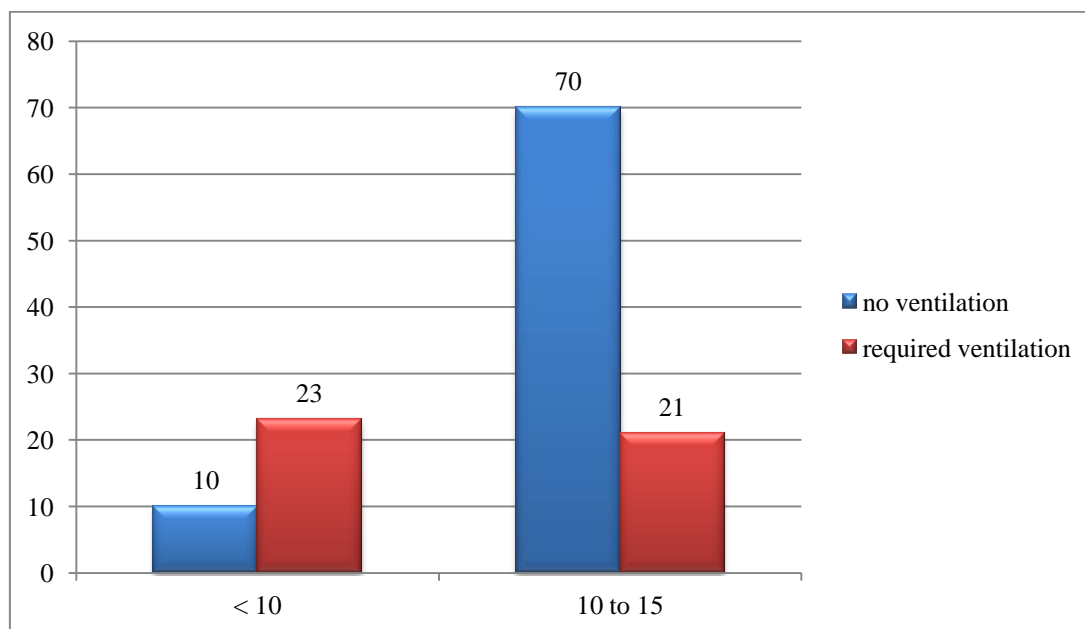


Graph 3: Relationship of fasciculation score with ventilation

Generalised fasciculations was another conspicuous feature in 72.6% 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 more likely to receive ventilation. (p~0.000)

Table 4 Relationship of GCS-score with ventilation

GCS	Ventilation required		Total
	No	Yes	
< 10	10	23	33
	30.3%	69.7%	26.6%
10- 15	70	21	91
	76.9%	23.1%	73.4%



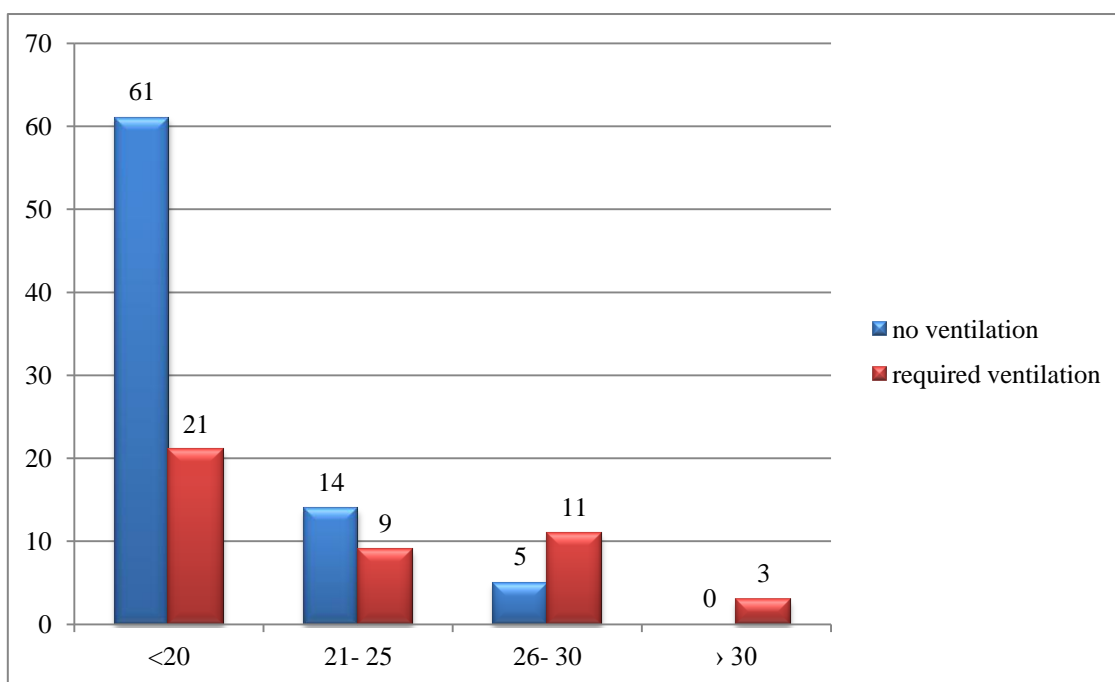
Graph 4: Relationship of GCS-score with ventilation

91 (73.4%) patients had a GCS- score of 10-15, out of these 21(23.1%) patients required ventilatory support. Ventilatory support was required by 69.7% of patients who had a GCS

score <10. Hence, patients with GCS-score <10 are more likely to receive ventilation when compared to the patients with GCS-score 10-15. (p~0.000)

Table 5: Relationship of respiratory rate with ventilation

RR	Ventilation required		Total
	No	Yes	
≤20	61	21	82
	74.4%	25.6%	66.1%
21 -25	14	9	23
	60.9%	39.1%	18.5%
26- 30	5	11	16
	31.2%	68.8%	12.%
≥ 30	0	3	3
	.0%	100.0%	2.4%

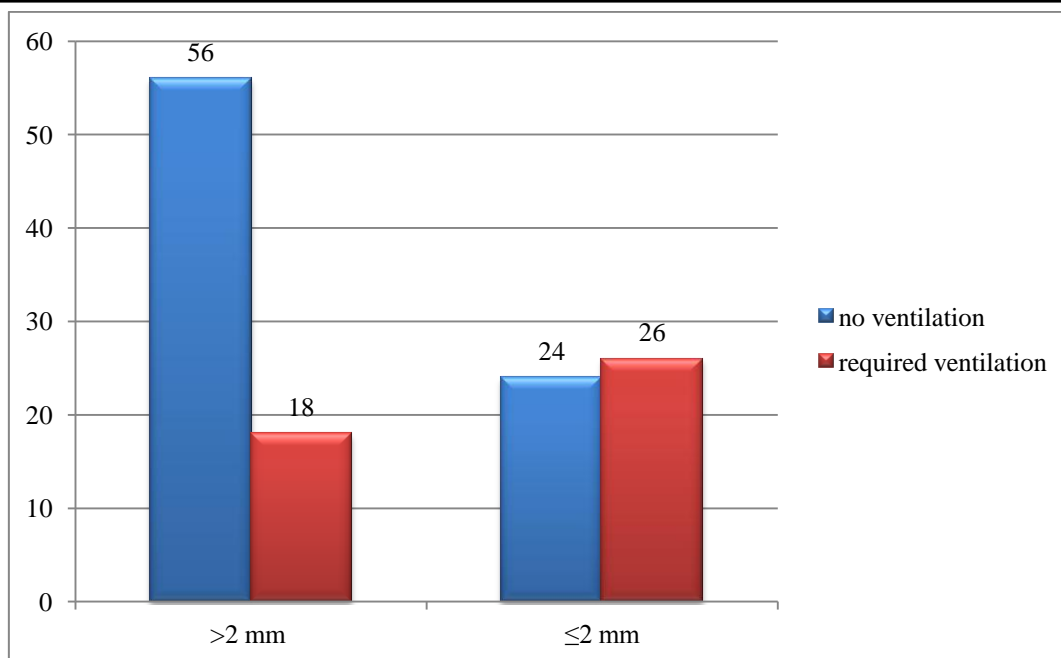


Graph 5: Relationship of respiratory rate with ventilation

100% of the patients with respiratory rate >30 breaths/minute required ventilator support, which is statistically significant with a P value ~0.001. 68.8% patients with RR- (26-30), 39.1% patients with RR-(21-25) and 21.6% with RR≤20 required ventilation.

Table 6: Relationship of pupil size at the time of admission with ventilation

Pupil size	Ventilation required		Total
	No	Yes	
> 2mm	56	18	74
	75.7%	24.3%	59.7%
≤ 2mm	24	26	50
	48.0%	52.0%	40.3%

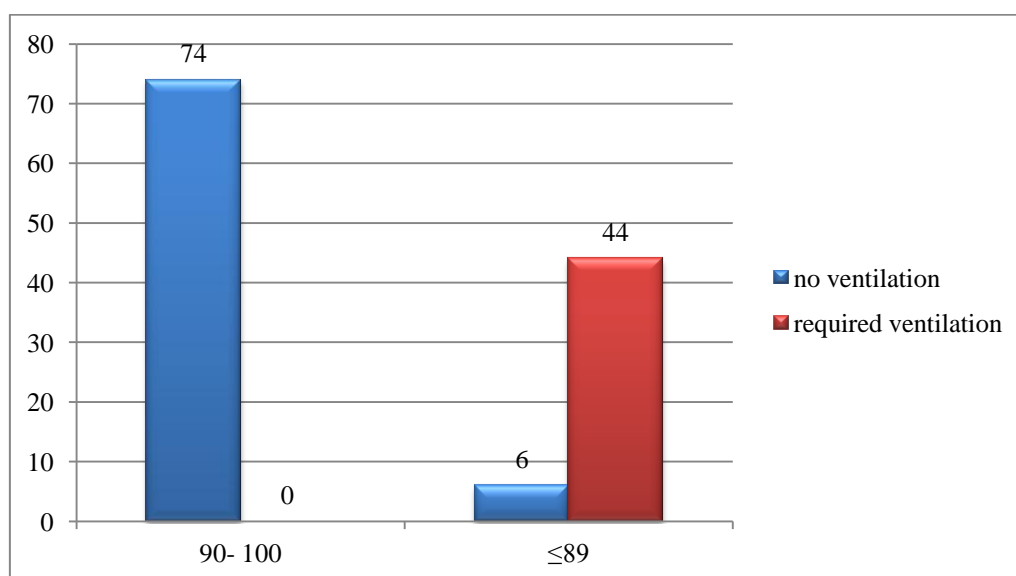


Graph 6: Relationship of pupil size at the time of admission with ventilation

Patients with pupil size ≤ 2 mm are 3.37 times more likely to require ventilation as compared to patients with pupil size >2 mm. This finding is statistically significant. ($p \sim 0.002$)

Table 7: Relationship of O₂ saturation with ventilation

O ₂ saturation	Ventilation required		Total
	No	Yes	
90- 100	74	0	74
	100.0%	.0%	59.7%
≤ 89	6	44	50
	12.0%	88.0%	40.3%

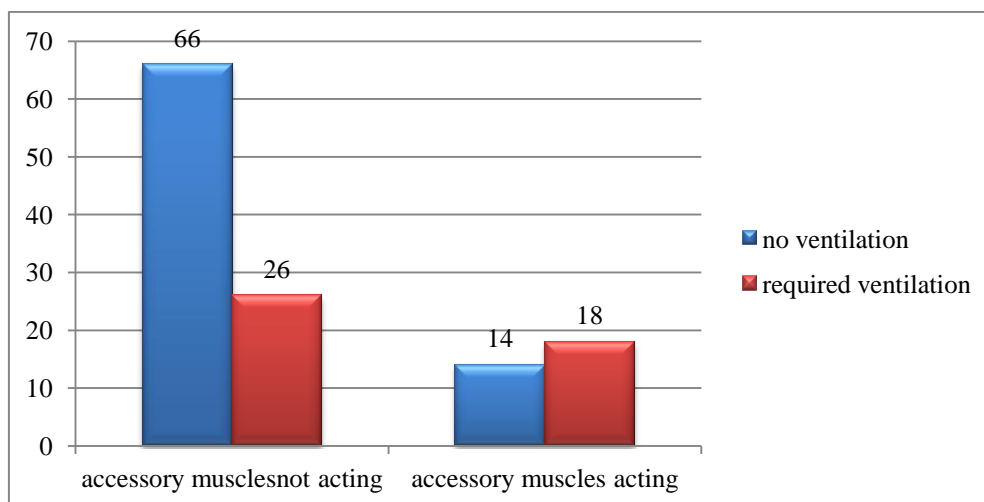


Graph 7: Relationship of O₂ saturation with ventilation

Of the 50 patients who had oxygen saturation levels of ≤ 89 % (without O₂), (88%) required ventilation support. Patients with saturation ≤ 89 % are 7.17 times more likely to receive ventilation support. ($p \sim 0.000$)

Table 8: Relationship of the use of accessory muscles with ventilation support

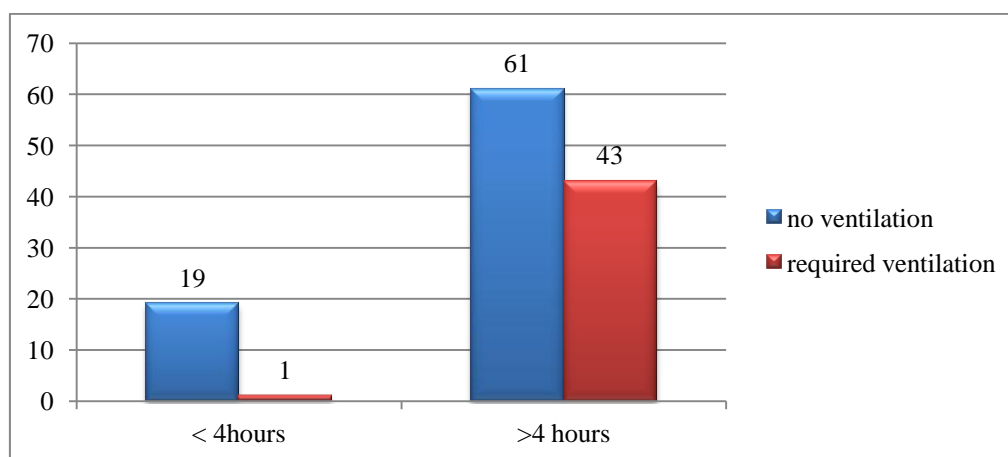
	Accessory muscles		Total
	No	Yes	
Not acting	66	26	92
	71.7%	28.3%	74.2%
Acting	14	18	32
	43.8%	56.2%	25.8%



Graph 8: Relationship of the use of accessory muscles with ventilation support 32(25.8%) patients had accessory muscles of (p~0.004). 28.3% without accessory muscles in respiration in action, of which 56.2% required action required ventilatory support. This is statistically significant.

Table 9: Relationship between time lag of consumption of poison and admission to the hospital with ventilation support

Duration between exposure and hospitalisation	Ventilation Required		Total
	No	Yes	
< 4hours	19	1	20
	95.0%	5.0%	16.1%
≥ 4 hours	61	43	104
	58.7%	41.3%	83.9%

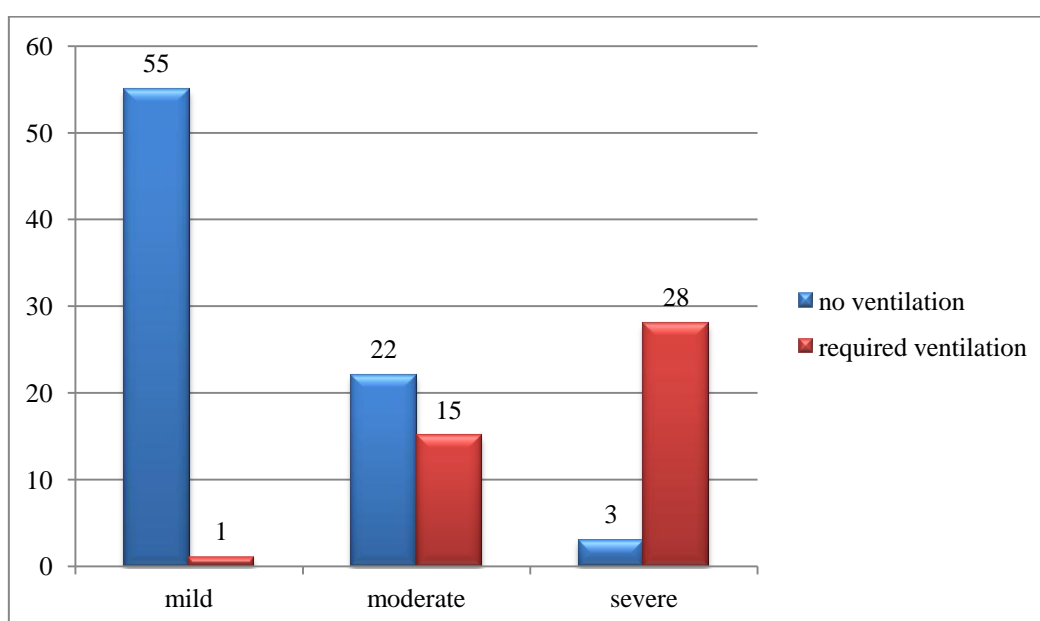


Graph 9: Relationship between time lag of consumption of poison and admission to the hospital with ventilatory support

Of the patients admitted to the hospital ≥ 4 hours after consumption of poison, 41.3% required ventilatory support. In comparison, patients admitted < 4 hours of consumption only 5% required ventilatory support. This finding is statistically significant. ($p \sim 0.002$)

Table 10: Requirement of ventilation support in relation to severity of organophosphorous compound poisoning

Severity	Ventilation required		Total
	No	Yes	
Mild	55	1	56
	98.2%	1.8%	45.2%
Moderate	22	15	37
	59.5%	40.5%	29.8%
Severe	3	28	31
	9.7%	90.3%	25%

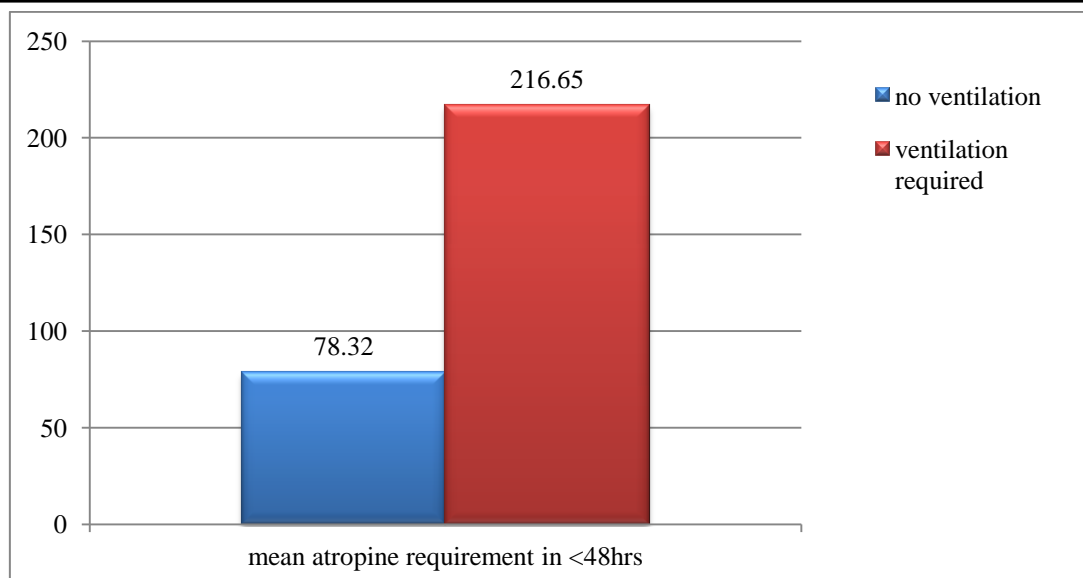


Graph 10: Requirement of ventilatory support in relation to severity of organophosphorous compound poisoning

1 (1.8%) of the patients with mild poisoning and 40.5% of the patients with moderate poisoning required ventilatory support. In contrast 90.3% of the patients with severe poisoning required ventilation which is statistically significant ($p \sim 0.000$).

Table 11: Relationship of atropine dose within 48 hours of admission with ventilation support

Required ventilation	Number	Dose	Std. Deviation	Std. Error Mean
No	80	78.32	58.286	6.517
Yes	44	216.55	87.006	13.117



Graph 11: Relationship of atropine dose within 48 hours of admission with ventilatory support

Patients who were ventilated required a higher dose of atropine (mean atropine dose-216.55mg) within 48 hours of admission as compared to those who were not ventilated (78.32mg). This is statistically significant ($p \sim 0.000$)

Discussion

This study shows 124 cases of organophosphorus poisoning over a span of 10 months in this institution which is a referral hospital. In a series of 312 cases of acute poisoning reported by Singh et al (1984)⁸⁹, organophosphorus compounds were recorded as the poisons used for suicidal purpose in 19.23% of cases. Diazinon seems to be the choice in majority of cases. Goel A et al reported 28% of cases of poisoning over one and half year period resulted from organophosphorus compound. The difference may be due to the fact that their study population was different from this study.

In this study peak incidence of 38.7% was in 26 to 35 years age group. The peak incidence of suicide as reported by Quinby (1968)⁹⁰, Balani (1968)⁹¹, Gupta and Patel (1965)⁹² was in third decade of life followed by second decade, whereas incidences described by Vishwanathan and Shrinivasan 1962⁹² was similar in both decades. Goelet al⁵ reported an incidence of 86.4% of cases including second and third decade.

In this study Chlorpyrifos was commonly used (38.7%). Ventilatory support requirement specially with diamethoate was more in the present study which was similar to Goel et al⁵ study.

Clinically vomiting, pain abdomen altered sensorium, hypersalivation, breathlessness were common symptoms in this study. 8 patients had convulsions in this study compared to Goelet al³² who reported 6.7%. Clinical signs like miosis, pungent odour, tachycardia; signs of respiratory insufficiency, fasciculations and altered sensorium were common in this study. Mutalik (1962)¹⁴ Balani (1968)⁹¹ Gupta and Patel (1968)⁹² Agarwal S.B. (1991)⁹⁵. Goel et al 1998⁵ also observed similar clinical scenario in their study.

With regard to grading of poisoning and its correlation of symptoms, 45.2% were of mild grade, 29.8% were of moderate grade and 25% were of severe grade. 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 Goelet al⁵, where 84% of the patients with GCS- score less than 10 required ventilation.

Respiratory failure was the commonest complication which may develop with 24hours after exposure^{39,40,48,50,51,42,54,55,57}. Early onset of respiratory failure is due to cholinergic over activity while late onset respiratory failure has been attributed to respiratory infections .44 out of

50 (88%) with saturation <89% required ventilator support.

Generalised fasciculations was another conspicuous feature in 72.6% of cases in this study. Whereas, studies done by Goelet al⁵ and Sarjit Singh et al⁵¹ showed that 55% and 100% of the patients respectively had fasciculations.

Of the 44 patients who required ventilator support, 28(63.6%) required it within first 24 hour after exposure to organophosphorus compound. Tsao et al (1990)⁴⁰ reported 40.2% of patients developed respiratory failure of which 80.2% developed during 24 hours after exposure. Relationship between delay in institution of specific treatment and survival was found to be insignificant by Karthik et al⁵¹ but Goel et al⁵ showed significant relationship between delay in treatment and requirement of ventilatory support. Present study also shows that 104 patients had time lag of 4 or more hours for initial treatment of which 43(41.3%) required ventilatory support.

Fifty (40.3%) patients had pupil size ≤ 2 mm of which 26 (52%) patients required ventilatory support. According to the study done by OP Gupta et al⁹² 28% had pupil size ≤ 1 mm who required ventilatory support. In comparison, in a study done by Robert et al⁷⁴ 73% who had pupil size ≤ 1 mm required ventilation.

Only 1 out of 56 patients required ventilatory support with mild poisoning, 15 of 37 patients with moderate poisoning required ventilator support and 28 out of 31 patients with severe poisoning required ventilatory support

Conclusion

The presence of higher fasciculation score (≥ 4), GCS score ≤ 10 , pupil size ≤ 2 mm, respiratory rate (>25 breaths/minute) and accessory muscles of respiration, O₂ saturation of ≤ 89 mmHg, higher dose of atropine within 48 hours of admission, time lag ≥ 4 hrs, and dimethoate consumption were found to be predictors for ventilatory support in organophosphorous poisoning.

Limitation of the Study

The study excludes the subjects those given atropine in other hospitals before being referred.

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