A STUDY OF PREDICTING THE NEED FOR VENTILATOR SUPPORT AND OUTCOME IN ORGANOPHOSPHORUS POISONING

Kalinga Bommankatte Eranaik[1], Nagraj[2], Basith Lateef Kardkal[3]

[1]Assistant Professor, Department of General Medicine, Karnataka Institute of Medical Sciences, Hubli, Karnataka.
[2]Postgraduate Student, Department of General Medicine, Karnataka Institute of Medical Sciences, Hubli, Karnataka.
[3]Postgraduate Student, Department of General Medicine, Karnataka Institute of Medical Sciences, Hubli, Karnataka.

ABSTRACT

BACKGROUND

Organophosphorus compound poisoning is the most common poisonings in India because of easy availability, often requiring ICU care and ventilator support. Clinical research has indicated that respiratory failure is the most important cause of death due to Organophosphorus poisoning. It results in respiratory muscle weakness, pulmonary oedema, respiratory depression, increased secretions and bronchospasm. These complications and death can be prevented with timely Institution of ventilator support.

The aim of present study was to identify the factors and predicting the need for ventilator support and outcome.
Aim of the Study- To predict the need for ventilator support and outcome in organophosphate poisoning.

MATERIALS AND METHODS

Seventy consecutive patients admitted with a history of organophosphorus poisoning at KIMS, Hubli were taken for study after considering the inclusion and exclusion criteria. Detailed history, confirmation of poisoning, examination and other than routine investigations serum pseudocholinesterase and arterial blood gas analysis was done. The severity of organophosphorus poisoning was graded as mild, moderate and severe based on the factors which influence the need for ventilator support.

RESULTS

This study was conducted in 70 patients, out of which 48 (68.6%) were male patients and 22 (31.4%) were female patients. Among them 37 (53%) patients required ventilation and 33 (47%) expired. Chlorpyrifos, Dichlorvos and Monocrotophos were most commonly consumed poisons. 74% patients who consumed these compounds required ventilator support and 73% patients expired. 100% of patients presented with pin point pupil, fasciculation score > 4, respiratory rate > 20, GCS score < 7 and severe grade of poisoning required ventilator support and pseudocholinesterase < 900 U/L, 70% of metabolic acidosis and atropine requirement more than 180 mg within 48 hours required ventilator support and associated with high mortality.

CONCLUSION

Patients who presented with pinpoint pupils, bradycardia, higher respiratory rate, generalised fasciculation, low GCS score, low pseudocholinesterase levels, moderate-to-severe grade of poisoning, metabolic acidosis and higher requirement of atropine within 48 hours were the strong predictors of ventilation in organophosphorus poisoning and associated with high mortality.

KEYWORDS

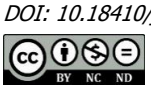
Organophosphorus Poisoning, Ventilator, Pseudocholinesterase, Fasciculation, Atropine.

HOW TO CITE THIS ARTICLE: Eranaik KB, Nagraj, Kardkal BL. A study of predicting the need for ventilator support and outcome in organophosphorus poisoning. J. Evid. Based Med. Healthc. 2017; 4(29), 1674-1681. DOI: 10.18410/jebmh/2017/327

BACKGROUND

Organophosphorus compound poisoning is the most common poisonings in India because of easy availability, often requiring ICU care and ventilatory support.[1]

Financial or Other, Competing Interest: None.
Submission 15-03-2017, Peer Review 22-03-2017,
Acceptance 03-04-2017, Published 07-04-2017.
Corresponding Author:
Dr. Kalinga Bommankatte Eranaik,
Assistant Professor,
Department of General Medicine,
Karnataka Institute of Medical Sciences, Hubli, Karnataka.
E-mail: kalingasdm@gmail.com
DOI: 10.18410/jebmh/2017/327



The WHO estimates the number of acute pesticide poisoning at 3 million cases per year and mortality of 200000 deaths per year. In developing country like India, acute organophosphorus compound poisoning is a common cause of mortality. High toxicity of locally available poisons may be the probable causes of high mortality in addition to difficult transportation, few of health care workers, lack of training facilities and non-availability of antidotes.[1]

It is observed that in majority of individual cause of the deaths occur due to respiratory failure occurring in one of the two distinct clinical syndromes. Acute cholinergic respiratory failure or the intermediate syndrome and respiratory paralysis.[2]

The Intermediate syndrome,which is a frequent cause of respiratory failure in addition to the conventional presentation of organophosphorus poisoning induced acute cholinergic crisis is a frequent cause of respiratory failure. The cardinal features of this syndrome are cranial nerve palsies, weakness of neck muscles, proximal muscle weakness and respiratory muscle paralysis, which usually develops between 24 to 96 hours of ingestion of poison. In such condition, mortality can be reduced by early treatment of the syndrome with antidotes and prompt ventilation.[3,4] Hence, this study was undertaken to identify the factors, which predict the need for ventilatory support in patients with organophosphorus compound poisoning and its outcome.

AIMS AND OBJECTIVES

To predict the need for ventilator support and outcome in organophosphate poisoning.

MATERIALS AND METHODS

Seventy patients presenting with history of organophosphorus poisoning at KIMS, Hubli were included in the study.

Inclusion Criteria

Patients presenting with history of consumption of Organophosphorus compound poisoning were included in this study.

Exclusion Criteria

1. Patients with concomitant illness or conditions (eg. Muscular dystrophy, Myasthenia gravis and Cardiac diseases) that are likely to alter the respiratory effort due to organophosphorus compound poisoning.
2. Patients who consumed other poisons along with organophosphorus compound.
3. Patients with chronic lung disease.
4. Organophosphorus poisoning in pregnant female.

Statistical Methods

Chi-square test has been used to find the significance of ventilation requirement for all the study parameters. Student's 't' test was used to find the significance of mean difference of atropine within 48 hours between ventilated and not ventilated patients.

Statistical Software

The Statistical software namely SPSS 11.0 was used for the analysis of the data.

Based on factors that influence the need for ventilator support, the severity of organophosphorus compound poisoning was graded as mild, moderate and severe poisoning.[5]

Mild Poisoning Included

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

Moderate Poisoning Included

- Altered sensorium (score of 8 - 11 by GCS).
- Pupil size 2 - 3 mm.
- Fasciculation score 2 - 4.

Severe Poisoning Included

- Stupor/Coma (Score of 7 or less by GCS).
- Pinpoint pupil (1 mm or less).
- Fasciculation score 5 or more.
- Presence of seizures.
- Respiratory insufficiency.

Grading of Fasciculation

It was done by giving 1 point depending on the presence of fasciculations 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 is thus estimated.

Grading of Poisoning done by Pseudocholinestrases Level

Mild poisoning : 40 - 60% of normal range.
Moderate poisoning : 20 - 40% of normal range.
Severe poisoning : less than 20% of normal range.

RESULTS

Seventy patients diagnosed to have consumed organophosphorus compound poison were studied in relationship to the need for ventilator support and its outcome. In a total target study of 70 patients, 37 (52.85%) patients required ventilator support, out of which 26 (37.1%) patients have died. This study consists of 48 (68.6%) male patients and 22 (31.4%) female patients. Among them, 37 (53%) patients required ventilation and 33 (47%) expired. Chlorpyrifos, Dichlorvos and Monocrotophos were most commonly consumed poisons. 74% patients who consumed these compounds required ventilator support and 73% patients expired. 100% of patients presented with pinpoint pupil, fasciculation score > 4, respiratory rate > 20, GCS score < 7 and severe grade of poisoning required ventilator support and pseudocholinesterase < 900 U/L, 70% of metabolic acidosis and atropine requirement more than 180 mg within 48 hours required ventilator support and associated with high mortality.

Age in Years (n = 70)	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
13 - 20	12 (17.1%)	9 (24.3%)	7 (26.9%)
21 - 30	31 (44.3%)	13 (35.1%)	7 (26.9%)
31 - 40	14 (20%)	9 (24.3%)	8 (30.8%)
> 40	13 (18.6%)	6 (16.2%)	4 (15.4%)

Table 1. Relationship of Age Distribution with Ventilation and Outcome

Sex (n = 70)	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
Female	22 (31.4%)	10 (45.5%)	8 (36.4%)
Male	48 (68.6%)	27 (56.2%)	18 (37.5%)

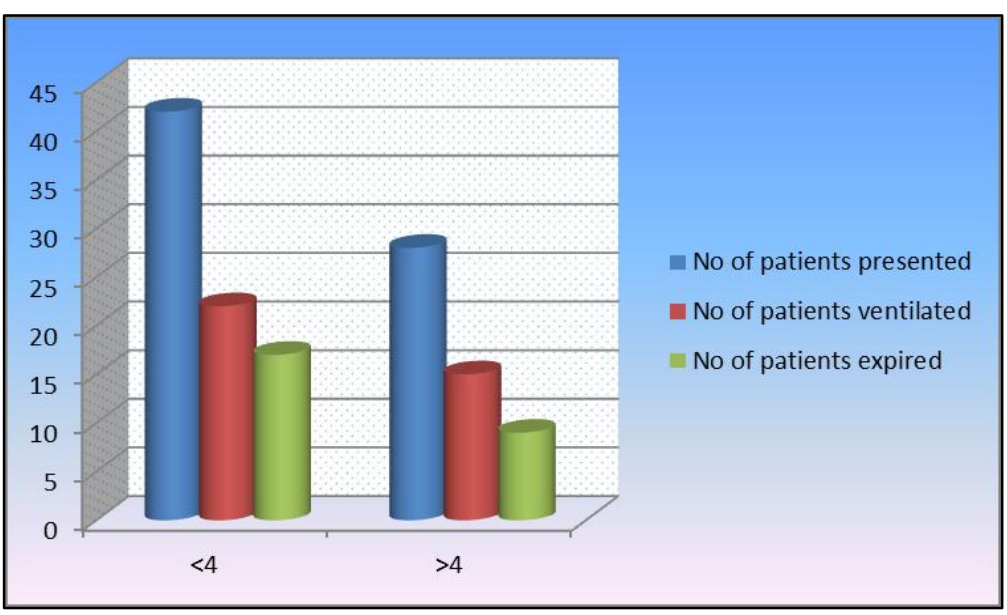
Table 2. Relationship of Sex with Ventilation and Outcome

Compounds	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
Acephate	1 (1.4%)	0	0
Chlorpyrifos	22 (31.4%)	11 (29.7%)	8 (30.8%)
Dichlorvos	11 (15.7%)	7 (18.9%)	5 (19.2%)
Dimethoate	5 (7.1%)	0	0
Malathion	2 (2.9%)	2 (5.4%)	1 (3.8%)
Methyl parathion	1 (1.4%)	1 (2.7%)	1 (3.8%)
Monocrotophos	19 (27.1%)	10 (27%)	6 (23.1%)
Profinofos	3 (4.3%)	3 (8.1%)	3 (11.5%)
Triazophos	3 (8.6%)	3 (8.1%)	2 (7.7%)

Table 3. Relationship of Organophosphorus Compounds Consumed with Ventilator Support and Outcome

Time Lag in Hours	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n= 37)	Number of Patients Expired (n= 26)
< 4	42 (60%)	22 (59.5%)	17 (65.4%)
> 4	28 (40%)	15 (40.5%)	9 (34.6%)

Table 4. Relationship between Time Lag in Hours with Ventilator Support and Outcome



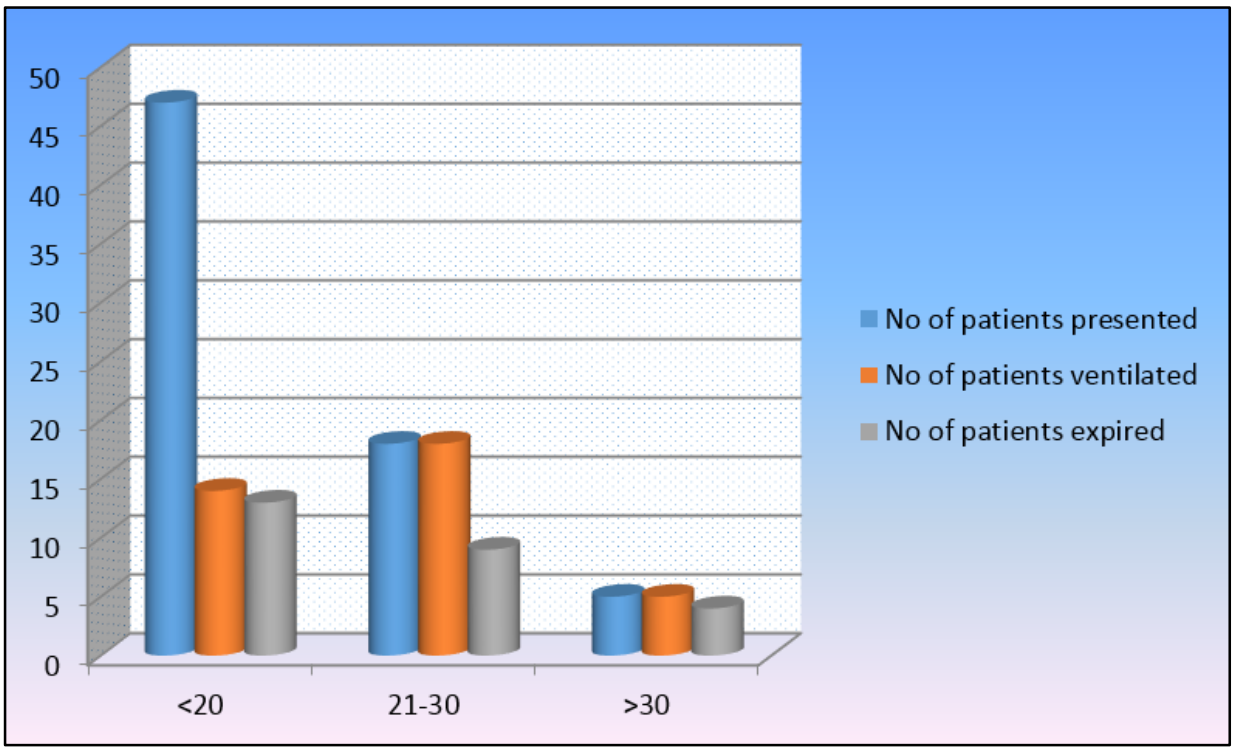
Graph 1. Graphical Representation of Relationship between Time Lag in Hours with Ventilator Support and Outcome

Pulse Rate (In BPM)	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
< 60	19 (27.1%)	17 (45.9%)	11 (42.3%)
61 - 70	15 (21.4%)	8 (21.6%)	6 (23.1%)
> 70	36 (51.5%)	12 (32.4%)	9 (34.6%)

Table 5. Relationship of Pulse Rate with Ventilation and Outcome

Respiratory Rate (In CPM)	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
< 20	47 (67.1%)	14 (37.8%)	13 (50%)
21 - 30	18 (25.7%)	18 (48.6%)	9 (34.6%)
> 30	5 (7.2%)	5 (13.5%)	4 (15.4%)

Table 6. Relationship of Respiratory Rate with Ventilation and Outcome



Graph 2. Graphical Representation of Relationship of Respiratory Rate with Ventilation and Outcome

Pupil Size (In cms)	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
< 1	17 (24.3%)	17 (45.9%)	15 (57.7%)
2 - 3	35 (50%)	18 (48.6%)	11 (42.3%)
> 4	18 (25.7%)	2 (5.4%)	0

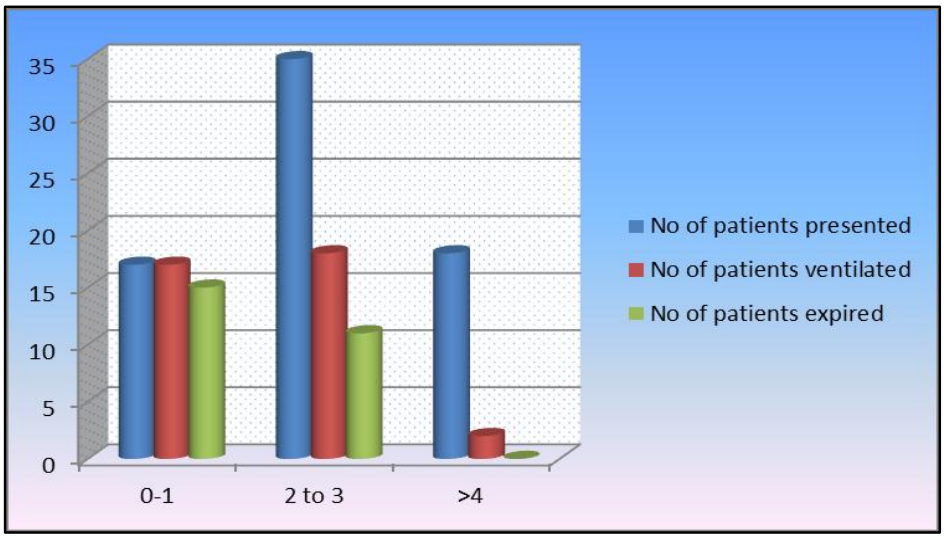
Table 7. Relationship of Pupil Size with Ventilation and Outcome

Fasciculation Score	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
0 - 1	25 (35.7%)	4 (10.8%)	3 (11.5%)
2 - 4	26 (37.1%)	14 (37.8%)	6 (23.1%)
> 4	19 (27.2%)	19 (51.4%)	17 (65.4%)

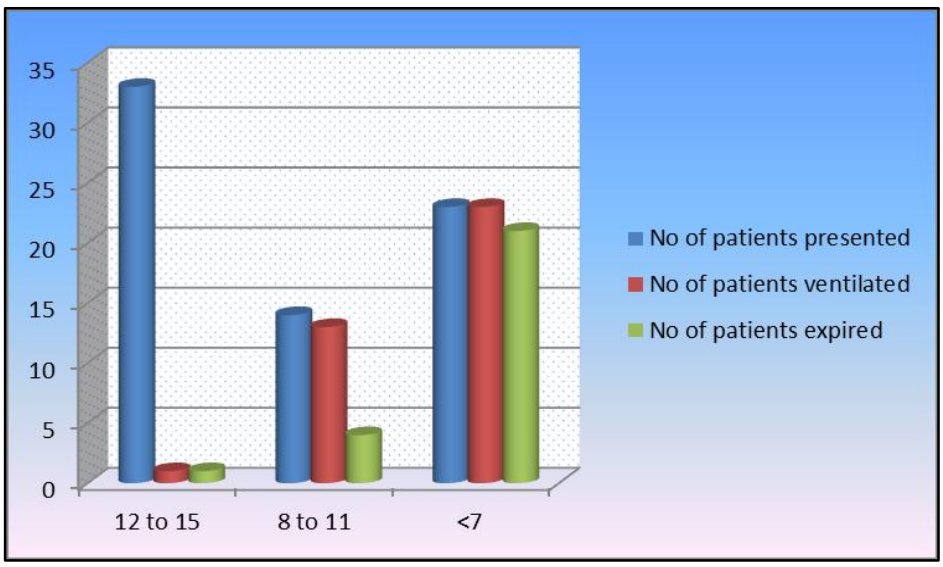
Table 8. Relationship of Fasciculation Score with Ventilation and Outcome

GCS Score	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
12 - 15	33 (47.1%)	1 (2.7%)	1 (3.8%)
8 - 11	14 (20%)	13 (35.1%)	4 (15.4%)
< 7	23 (32.9%)	23 (62.2%)	21 (80.8%)

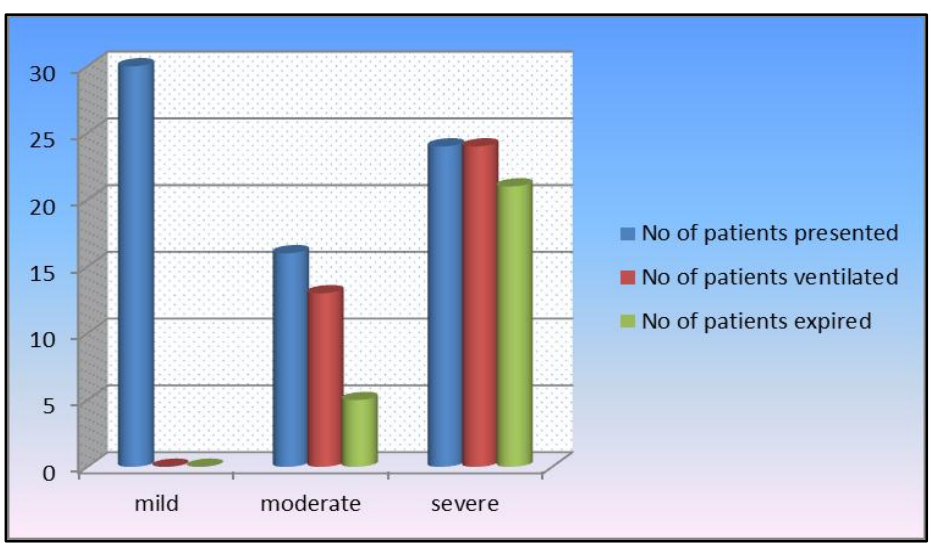
Table 9. Relationship of GCS Score with Ventilation and Outcome



Graph 3. Graphical Representation of Relationship of Fasciculation Score with Ventilation and Outcome



Graph 4. Graphical Representation of Relationship of GCS Score with Ventilation and Outcome



Graph 5. Graphical Representation of Relationship of Severity of Organophosphorus Poisoning with Ventilation and Outcome

Pseudocholinesterase (in U/L)	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
< 900	38 (54.3%)	27 (73%)	21 (80.8%)
900 - 1200	8 (11.4%)	3 (8.1%)	3 (11.5%)
> 1200	24 (34.3%)	7 (18.9%)	2 (7.7%)

Table 10. Relationship of Pseudocholinesterase with Ventilation and Outcome

ABG Analysis	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
Normal	21 (30%)	2 (5.4%)	0
Metabolic acidosis	35 (50%)	26 (70.3%)	21 (80.8%)
Metabolic alkalosis	1 (1.4%)	1 (2.7%)	0
Respiratory acidosis	7 (10%)	4 (10.8%)	3 (11.5%)
Respiratory alkalosis	6 (8.6%)	4 (10.8%)	2 (7.7%)

Table 11. Relationship of ABG Analysis with Ventilation and Outcome

Severity of Poisoning	Number of Patients Presented (n = 70)	Number of Patients Ventilated (n = 37)	Number of Patients Expired (n = 26)
Mild	30 (42.8%)	0	0
Moderate	16 (22.9%)	13 (35.1%)	5 (19.2%)
Severe	24 (34.3%)	24 (64.9%)	21 (80.8%)

Table 12. Relationship of Severity of Organophosphorus Poisoning with Ventilation and Outcome

	Atropine Dose (mg) within 48 hrs.	
	Number of Patients	Mean ··SD
Ventilated	37	198.24 ·····
Not ventilated	33	89.33·····
Significance Student t	Student t= 4.801 p= 0.001	

Table 13. Relationship of Atropine Dose within 48 hrs. of Admission with Ventilation

	Atropine Dose (mg) within 48 hrs.	
	Number of Patients	Mean ··SD
Expired	26	184.81 ·····
Improved	44	124.5·····
Significance Student 't'	Student t= 2.308, P= 0.001	

Table 14. Relationship of Atropine Dose within 48 hrs. of Admission with Outcome

Factors	Number of Patients Ventilated	Number of Patients Not Ventilated	P value	Number of Patients Expired	Number of Patients Improved	P value
Chlorpyrifos	11 (29.7%)	11 (33.3%)	0.02	8 (30.8%)	14 (31.8%)	0.197
Monocrotophos	10 (27%)	9 (27.3%)	0.127	6 (23.1%)	13 (29.5%)	0.75
Pulse rate < 60 bpm	17 (45.9%)	2 (6.1%)	0.001	11 (42.3%)	8 (18.2%)	0.001
Respiratory rate > 20 cpm	23 (62.1%)	0	0.001	13 (50%)	10 (22.8%)	0.001
Pupil size < 1 cm	17 (45.9%)	0	0.001	15 (57.7%)	2 (4.5%)	0.001
Fasciculation score > 4	19 (51.4%)	0	0.001	17 (65.4%)	2 (4.5%)	0.001
GCS score < 11	36 (97.3%)	1 (3%)	0.001	25 (96.2%)	12 (27.2%)	0.001
Pseudocholinesterase <900 U/L	27 (73%)	11 (33.3%)	0.001	21 (80.8%)	17 (38.6%)	0.001
Metabolic acidosis	26 (70.3%)	9 (27.3%)	0.001	21 (80.8%)	14 (31.8%)	0.001
Moderate poisoning	13 (35.1%)	3 (9.1%)	0.05	5 (19.2%)	11 (25%)	0.05
Severe poisoning	24 (64.9%)	0	0.001	21 (80.8%)	3 (6.8%)	0.001
Atropine Dose within 48 hrs.	37 (52.8%)	33 (47.2%)	0.001	26 (37.2%)	44 (62.8%)	0.001

Table 15. Factors Predicting the need for Ventilator Support and Outcome

DISCUSSION

Acute organophosphorus compound poisoning is one of the most frequent poisonings encountered in KIMS, Hubli. The major cause of poisoning in the present study was attempted suicides (85%). Suicide is the major cause of poisoning in developing countries.[6]

In contrast, figures from developed countries like Japan showed accidental exposure forms as a major bulk of organophosphorus compound poisoning.

Among the 70 cases studied, majority of the patients were in the age group of 21 - 30 years accounting for 44% involving the productive group of the society. This correlates with the study done by S Singh et al.[7]

In the present study, 68% of the patients were males. This correlates with the findings of the previous studies. However, in a study done by M Vishwanathan et al,[8] 66% of the patients who consumed organophosphorus compound were females.

Vomiting was the most common symptom in 80% of the patients in this study. This correlates with the studies done by Tsao et al,[9] Namba et al[10] and Goel et al[11] where 44%, 42% and 97% respectively. Vomiting was probably due to chemical gastritis. 24% of the patients had pinpoint pupils and all of them had required ventilator support. According to the study done by Goel et al[11] 64%, Tsao et al[9] 52% and Rajeev H et al[12] 72% had pupil size < 1 mm required ventilator support.

Generalised fasciculation was seen in 27% of the cases and 100% of them have required ventilator support and 89% patients have expired. Goel et al[11] and Sarjith Singh et al[13] showed that 55% and 100% of the patients had fasciculations respectively. Rajeev H et al[12] showed that 100% of the patients presented with generalised fasciculation required ventilator support.

Bradycardia was present in 27% patients in this study. Among them 89% patients required ventilator support and 65% patients expired. This will correlate with the Shah Harsh et al[14] study where 100% and Semir Nouria[15] where 17% of the patients presented with bradycardia.

This has not been compared with the need for ventilation. 100% of patients with tachypnoea (RR > 20 cpm) required ventilator support (p = 0.001), among them 50% of the patients were expired. Respiratory insufficiency was seen in 40% of cases in a study done by Tsao et al[9] and it was 42% in the study done by Goel et al,[11] which are quite similar to our study. The tachypnoea was probably due to increased secretions and severe respiratory paralysis caused by the organophosphorus compound.

According to the study done by GS Mutalik et al[16] 40% of the patients had a respiratory rate more than 30 breaths/min, but this has not been compared with the need for ventilation. 73% of the patients presented with low pseudocholinesterase levels and required ventilator support and among them 81% patients died.

This will correlate with the Kumar S et al[17] study, where the mortality was high in patients with Pseudocholinesterase levels less than 20% as compared to patients with 40% - 60% of normal levels. Rajeev et al[12] showed that 84% of the patients presented with pseudocholinesterase levels, less than 20% of the normal values required ventilator support.

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[11] and Rajeev et al.[12] Higher dose of atropine may indirectly indicate the severity of poisoning, which might have caused respiratory paralysis requiring ventilation.

The severity of organophosphorus compound poisoning and the need for ventilator support was studied in relationship of the nature of the compounds consumed. 50% of the patients who consumed Chlorpyrifos and 51% of the patients who consumed monocrotophos poison required ventilator support in this study. Whereas, in the study done by Goel et al 66.7% of the cases who had consumed Dimethoate was associated with maximum need of ventilator support. Rajeev et al[12] showed that Methyl parathion was the most consumed poison (60%) requiring ventilator support, which accounts for 12% of total deaths.

Ventilator support was required for 97% of patients who had GCS score less than 11. This correlates very well with the study done by Goel et al[11] (96%) and Rajeev et al[12] of the patients with the GCS score less than 11 required ventilation. 100% of the patients with severe grade of poisoning and 80% of the patients with moderate grade poisoning required ventilator support. Studies done by Goel et al[11] have shown that about 4% of the mild, 6% of the moderate and 62% of the severe poisoning required ventilator support. Rajeev et al[12] showed that 66% of moderate and 99% of the severe grade poisoning required ventilator support and 8% of the patients expired. Whereas, in our study 87% of severe grade and 31% of moderate grade poisoning patients expired.

Of the patients admitted to the hospital for < 4 hours after consumption of poison, 60% required ventilator support and 65% of patients expired compared to patients admitted > 4 hours of consumption, 41% required ventilator support and 35% patients expired. The study done by Karnik et al[18] found that this delay was statistically insignificant. Goel et al[11] and Kumar S et al[17] showed a significant relationship between delay in treatment and need for ventilator support.

Factors which predicted the need for ventilator support and outcome in this study are pinpoint pupils, bradycardia, higher respiratory rate, generalised fasciculation, low GCS score, low pseudocholinesterase levels, moderate-to-severe grade of poisoning, metabolic acidosis and higher requirement of atropine within 48 hours. This study showed that age, sex, type of compound consumed and time lag in hours were not helpful in predicting the need for ventilator support and outcome.

CONCLUSION

Patients who presented with pinpoint pupils, bradycardia, higher respiratory rate, generalised fasciculation, low GCS score, low pseudocholinesterase levels, moderate-to-severe grade of poisoning, metabolic acidosis and higher

requirement of atropine within 48 hours were the strong predictors of ventilation in organophosphorus poisoning and associated with high mortality. The relationship between age, sex, type of compound consumed and time lag in hours in predicting the need for ventilator support and outcome were not statistically significant.

REFERENCES

[1] Ahmed SM, Das B, Nadeem A, et al. Survival pattern in patients with acute organophosphate poisoning on mechanical ventilation: a retrospective intensive care unit-based study in a tertiary care teaching hospital. Indian J Anaesth 2014;58(1):11-17.

[2] Eddleston M, Buckley NA, Eyer P, et al. Management of acute organophosphorus pesticide poisoning. Lancet 2008;371(9612):597-607.

[3] Jayawardane P, Karalliedde L, Senanayake N, et al. The spectrum of intermediate syndrome following acute organophosphate poisoning: a prospective cohort study from Sri Lanka. PLoS Med 2008;5(7):e147.

[4] Singh S, Sharma N. Neurological syndromes following organophosphate poisoning. Neurology India 2000;48(4):308-313.

[5] Davies JO, Eddleston M, Buckley NA. Predicting outcome in acute organophosphorous poisoning with poison severity score or the glasgow coma scale. QJM 2008;101(5):331-339.

[6] Karalliedde L, Senanayake N. Organophosporous insecticide poisoning. British Journal of Anaeasthesia 1989;63:736-750.

[7] Singh S, Sharma BK, Chug KS. Spectrum of acute poisoning in adults (10 year experience). JAPI 1984;32(7):561-563.

[8] Vishwanathan M, Srinivasan K. Poisoning by bug poison. A preliminary study. Journal of Indian Medical Association 1962;39(7):345-349.

[9] Tsao TC, Juang YC. Lan RS, et al. Respiratory failure of acute OP poisoning and carbamate. Chest 1990;98(3):631-636.

[10] Namba T, Nolte CT, Jackrel J, et al. Poisoning due to organophosphate insecticide. American Journal of Medicine 1971;50(4):475-492.

[11] Goel A, Joseph S, Dutta TK. Organophosphate poisoning: predicting the need for ventilator support. J Assoc Physicians India 1998;46(9):786-790.

[12] Rajeev H, Arvind MN. Study of clinical and biochemical parameters in predicting the need for ventilator support in organophosphorus compound poisoning. Journal of Evolution of Medical and Dental Sciences 2013;2(49):9555-9570.

[13] Singh S, Balkrishnana, Satwant Singh, Vinod Malhotra. Parathion poisoning in Punjab (A clinical and electrocardiological study of 20 cases). JAPI 1969;16:181-187.

[14] Harsh S, Prakash M, Ram OV, et al. Acute organophosphorus poisoning and clinical admission score association among patients admitted in emergency ward of a tertiary teaching hospital of medical college. Journal of Pharmaceutical and Biomedical Sciences 2012;17.

[15] Nouria S, Abroug F, Elatrous S, et al. Prognostic value of serum cholinesterase in organophosphorous poisoning. Chest 1994;106(6):1811-1814.

[16] Mutalik GS, Wadia RS and Pai VR. Poisoning by diazinon an organophosphorous insecticide. Journal of Indian medical association 1962;38:67-71.

[17] Kumar SS, Jayarajan A, Kuppaswamy G. Continuous infusion of high dose of atropine in management of organophosphorous poisoning. JAPI 1991;39(2):190-193.

[18] Karnik VM, Ichaporia RN, Wadia RS. Cholinesterase levels in diazionon poisoning. I. relation to severity of poisoning. JAPI 1970;18(3);337-334.