Clinical Outcome of Mechanically Ventilated Patients of Organo-Phosphorous Compound Poisoning

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ABSTRACT

BACKGROUND

Organo phosphorous compound poisoning is one of the most common suicidal poisonings in India. The various clinical entities that determine the clinical course and outcome in the ICU of OPC poisoning patient are type of the compound and dose of poison. Delayed presentation and multi-organ failure are some of the major factors that decide the outcome of the patient. This study was conducted to assess the clinical outcome of patients with OPC poisoning on assisted ventilation and assess the various factors that determine the outcome.

METHODS

A prospective observational study was conducted for a period of 6 months at a government tertiary care hospital in Chennai. All patients with history and clinical signs of OPC poisoning requiring mechanical ventilation for respiratory support were included as our study subjects. Outcome of patients was measured in terms of either recovery or death and factors influencing the outcome such as type of OPC compound, amount consumed, onset and duration of respiratory muscle weakness and pseudocholinesterase levels were considered.

RESULTS

In the 172 subjects, 108 (62.7 %) patients were successfully extubated from mechanical ventilator and 64 (37.2 %) patients expired. Patients aged more than 40 years, patients who consumed methyl parathion with quantity of poison more than 50 ml, patients with serum cholinesterase levels less than 500, patients who were atropinised for more than 3 days and who were on mechanical ventilation for more than 3 days were the factors found to have a statistically significant association ($P < .05$) for causing death among patients with OPC poisoning.

CONCLUSIONS

The mortality among the OPC poisoning patients who were on mechanical ventilation was found to be very high. Early resuscitation of patients with OPC poisoning might reduce the morbidity and mortality.

KEYWORDS

Organo-Phosphorous Compound Poisoning, Mechanical Ventilation, Clinical Outcome

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DOI: 10.18410/jebmh/2021/132

How to Cite This Article:
Prakash S, Ramamoorthy G, Shankar R. Clinical outcome of mechanically ventilated patients of organo-phosphorous compound poisoning. J Evid Based Med Healthc 2021;8(12):672-676. DOI: 10.18410/jebmh/2021/132

Submission 30-11-2020,
Peer Review 10-12-2020,
Acceptance 18-01-2021,
Published 22-03-2021.

BACKGROUND

Organo-phosphorous compounds are one of the main pesticides being widely used for pest control in agriculture, and India being an agriculture based country, its usage is very common.[1] Farmers due to their continuous exposure to these pesticides are more prone to develop accidental over exposure which might cause poisonous effect and moreover because of its low cost and easy availability it has become one of the major products for suicidal poisoning.[2] According to the reports of World Health Organization, (WHO) annually around 0.3 million people die due to acute poisoning and among them about 2 lakh deaths are mainly due to organophosphorous poisoning alone, with more deaths reporting in developing countries like India.[3,4,5]

The pathogenesis behind OP insecticides is that it inhibits both cholinesterase and pseudocholinesterase enzyme activities which are irreversible inhibitors, by inhibiting the cholinesterase activity it leads to accumulation of acetylcholine at synapses of the neurons which produces overstimulation and disruption of neurotransmission in both central and peripheral nervous systems resulting in cholinergic crisis, characterised by range of muscarinic effects like increased salivation / lacrimation / bronchial secretions, abdominal cramps, increased sweating, incontinence of urine & bowel, miosis, vomiting, bradycardia, hypotension and nicotinic effects like increased blood pressure, muscle spasms, twitching & fasciculations, along with tachycardia.[6,7]

Organo-phosphorous compound poisoning is associated with a very high mortality rate which is often attributed to late diagnosis and improper management. Early diagnosis and appropriate treatment at a tertiary care centre could possibly be lifesaving, although the clinical course of this type of poisoning might be quite severe and majority of the patients might require mechanical ventilation in an intensive care unit. There are various clinical entities that can determine the clinical course and outcome in the ICU, along with it the type and dose of poison, delayed presentation and multi-organ failure are some of the major factors that decides the outcome of the patient.[8,9]

The mainstay in the treatment of OP poisoning is atropine which is a central and peripheral muscarinic receptor antagonist and along with it is pralidoxime chloride, which is considered as an antidote for OP poisoning and it acts by reactivating the inhibited acetyl cholinesterase.[10]

In recent years, some of the new adjunct medications such as sodium bicarbonate, magnesium sulfate as well as antioxidants have been shown some promising results in the management of OP poisoning.[11] Death in OP poisoning occurs due to respiratory failure because of paralysis of respiratory muscles and obstruction caused by bronchial secretions.[12] Most of the studies done earlier have only shown the clinical outcome of organophosphorous poisoning patients as a whole and not many studies on evaluating the outcome in patients with mechanical ventilation and so the present study was conducted to assess the clinical outcome of patients with OPC poisoning on assisted ventilation and to assess the various factors that determines the outcome.

METHODS

A prospective observational study was conducted for a period of 6 months, between June and November 2018, at a government tertiary care hospital in Chennai. The study was started after getting approval from the institutional ethical committee. All patients with history and clinical signs of OPC poisoning, requiring mechanical ventilation for respiratory support were included as our study subjects. Patients with liver or pancreatic disease, pregnant women, OPC poisoning patients not requiring mechanical ventilation were excluded from the study. A total of 172 study subjects were taken as our study sample based on inclusion and exclusion criteria. Informed consent was obtained from the guardians of the admitted patients.

Type of organo-phosphorous compound, approximate dose consumed, day of onset of intermediate syndrome, day of onset of respiratory difficulty which required mechanical ventilation, period of atropinisation, pupil size, Glasgow Coma Scale (GCS) were recorded in detail throughout the period of stay of the patient in the intensive care unit. Routine blood investigations like complete haemogram, serum electrolytes and renal function tests were periodically monitored. Serum cholinesterase levels were measured at the time of admission in intensive care unit. The reference range for serum cholinesterase was kept as 4000 - 11000. The outcome of patients was measured in terms of either recovery or death and factors influencing the outcome such as type of OPC compound, amount consumed, onset and duration of respiratory muscle weakness and pseudocholinesterase levels.

All data was entered and analysed using Statistical Package for the Social Sciences (SPSS) version 24. Continuous variables were expressed in mean and standard deviation and categorical variables were expressed as percentage. Statistical inference was obtained between two variables using chi-square test.

RESULTS

The age and gender wise distribution of our study subjects showed that majority of them were in the age group between 20 and 40 years with a mean age of 32.6 years and males were comparatively more in number than the females with a male: female ratio of 3.9:1, but no statistical significant difference was observed in the age group distribution between males and females (Table 1). According to their occupation, nearly 55 % were agriculture workers and 15 % were students among the study subjects, agricultural workers being more prone for OPC poisoning because of easy access to it. Almost all the study subjects were belonging to lower middle class or middle class according to their socio-economic status based on modified B G Prasad socio-economic status classification. In our study, 90 % of the patient's route of administration was through oral route and the remaining 10 % had the history of inhalational route. The four most common types of organo-phosphorous compounds being used by our subjects

were methyl parathion (41 %), monocrotophos (18 %), trichlorophos (13 %) and ethion (11 %), the other less common compounds used were profenophos, dimethoate, quinalphos and triazophos. The reference range of serum cholinesterase used in our study was 4,000 – 11,000 and majority of the patients' serum cholinesterase levels were less than 500 and nearly 23 % of the subjects' cholinesterase levels were between 500 – 999 with a mean level of 567.5 (Table 2). As because of a greater number of OPC poisoning, patients' serum cholinesterase levels were < 500, majority of patients required a greater number of days for atropinisation, more than 60 % required for 4 – 6 days and only 4 % required for less than 1 day with a mean of 4.3 days (Table 3). The amount of OPC consumed was between 50 – 150 ml in more than 80 % of the patients and only 2.3 % had consumed more than 150 ml (Table 4). The most common cause for mechanical ventilator support required for our subjects was acute cholinergic crisis (77.5 %) followed by type II respiratory failure (22.5 %). The requirement of mechanical ventilation was more than 3 days in 90 % of our patients in which about 26 % of them required it for 7 – 10 days with a mean of 4.8 days (Table 5). The outcome measurement was made based on either successful extubation or death. In the 172 subjects, 108 (62.7 %) patients were successfully extubated from mechanical ventilator and 64 (37.2 %) patients expired. Of the various factors influencing the outcome of the patients in mechanical ventilation, the unfavorable outcome, death was found to be more common among patients aged more than 40 years, patients who consumed methyl parathion with quantity of poison more than 50 ml, patients with serum cholinesterase levels less than 500, patients who were atropinised for more than 3 days and who were in mechanical ventilation for more than 3 days, all these factors were found to have a statistical significant association (P < .05) for causing death among OPC poisoning patients who were on mechanical ventilation.

Age Group	Male	Female	Total	Mean ± SD
< 20	21 (15.3 %)	7 (20 %)	28 (16.2 %)	32.6 ± 7.2
20 – 30	34 (24.8 %)	12 (34.2 %)	46 (26.7 %)	
31 – 40	55 (40.1 %)	10 (28.5 %)	65 (37.7 %)	
41 – 50	20 (14.5 %)	4 (11.4 %)	24 (13.9 %)	
> 50	7 (5.1 %)	2 (5.7 %)	9 (5.2 %)	
Total	**137 (100 %)**	**35 (100 %)**	**172 (100 %)**	

Table 1. Age and Sex Wise Distribution of the Study Subjects

Serum Cholinesterase Levels	Frequency	%	Mean ± SD
2001 – 3000	24	13.9 %	567.5 ± 291.8
1000 – 2000	27	15.6 %	
500 – 999	39	22.6 %	
< 500	82	47.6 %	
Total	**172**	**100 %**	

Table 2. Distribution of the Study Subjects Based on the Serum Cholinesterase Levels at the Time of Admission

Number of Days	Frequency	Percentage	Mean ± SD
< 1 day	8	4.6 %	4.3 ± 2.1
1 – 3 days	60	34.8 %	
4 – 6 days	104	60.4 %	
Total	**172**	**100 %**	

Table 3. Distribution of the Study Subjects Based on the Number of Days of Atropinisation

Volume of OPC	Frequency	Percentage
< 50 ml	27	15.6 %
50 – 100 ml	62	36 %
100 – 150 ml	79	45.9 %
> 150 ml	4	2.3 %
Total	**172**	**100 %**

Table 4. Distribution of the Study Subjects Based on the Volume of OPC Consumed

No. of Days on Mechanical Ventilator	Frequency	%	Mean ± SD
< 3 days	11	6.3 %	4.8 ± 2.1
3 – 6 days	116	67.4 %	
7 – 10 days	45	26.1 %	
Total	**172**	**100 %**	

Table 5. Distribution of the Study Subjects Based on the Number of Days on Mechanical Ventilator

Factor		Outcome: Extubated (N = 108)	Outcome: Death (N = 64)	P Value
Age	< 40 (N = 145)	96 (66.2 %)	49 (33.7 %)	< .001
	> 40 (N = 27)	12 (44.4 %)	15 (55.5)	
Sex	Male (N = 137)	85 (62 %)	52 (38 %)	0.518
	Female (N = 35)	23 (65.7 %)	12 (34.3 %)	
Type of OPC	Methyl parathion (N = 71)	25 (35.2 %)	46 (64.8 %)	< .001
	Other compounds (N = 101)	83 (82.1 %)	18 (17.9 %)	
Quantity consumed	< 50 ml (N = 145)	101 (69.6 %)	44 (30.4 %)	< .001
	> 50 ml (N = 27)	7 (25.9 %)	20 (74.1 %)	
Serum cholinesterase level	< 500 (N = 82)	23 (28 %)	59 (72 %)	< .0001
	> 500 (N = 90)	85 (94.4 %)	5 (5.6 %)	
Number of days of atropinisation	< 3 days (N = 68)	55 (80.8 %)	13 (19.2 %)	< .001
	> 3 days (N = 104)	53 (50.9 %)	51 (49.1 %)	
Number of days on mechanical ventilator	< 3 days (N = 11)	10 (90.9 %)	1 (10.1 %)	< .001
	> 3 days (N = 161)	98 (60.8 %)	63 (39.2 %)	

Table 6. Various Factors Influencing the Outcome among the Mechanical Ventilated Patients

DISCUSSION

OPC poisoning being one of the most common poisoning in Indian scenario, constitutes to one third of all poisoning. However, managing OPC poisoning is a challenging area among medical fraternities; the outcome of the patient depends on various factors such as type of OPC compound, quantity, days of atropinisation, days on ventilator etc. So, this study was conducted to study the outcome of OPC poisoning patients who were put on mechanical ventilator. This study was done on 172 OPC poisoning patients who were on mechanical ventilator.

In our study, the mean age of the study subjects was 32.2 years which was almost similar to the studies done by done by Zaheer et al. Gannur et al. and Nigam et al. in which majority of the patients age group was between 25 – 35 years.[13-15] Male predominance with a male: female ratio of 3.9: 1 was observed in our study and a similar pattern of ratio was quoted in the study done by Tanveer Hassan Banday et al., Safdar et al., and Aziza et al.[16-18] In our study, more than 95 % of the subjects had a history of suicidal poisoning and this was in agreement with studies done earlier which showed the incidence of self-poisoning was varying between 72 % and 97 %.19-21

As described in the other studies the most frequent signs noted in this study were miosis, increased salivation, anxiety and restlessness, bronchospasm and incontinence.[22,23] In the present study, the most common OPC compound used by majority of the patients was methyl parathion and it was almost in par with the studies done by Bhattarai et al. and Vilas et al., as because methyl parathion is very easily available and being the most common compound used by agricultural workers as a pesticide as it has a higher concentration of organo-phosphorous compared to other compounds.[24,25] The major route of poisoning in our study is oral route followed by inhalational route and similar to our results the study done by Rastogi et al. and M Eddleston et al. had also proven oral route being more common than other routes of poisoning.[4,26]

In the current study, 47 % of the study subjects had serum cholinesterase level less than 500 with a mean cholinesterase level of 567 IU, this was very much lower than the previously done studies as because those studies were done on all patients with OPC poisoning whereas our study was concentrated only on OPC poisoning patients who were on mechanical ventilation. The mortality rate in the present study was 37.2 % which is much higher than the previously done studies by Ahuja et al. (18 %) and Joshi and Patel (15.8 %) and another study done by Singh et al. the mortality reported was only 2.8 % and our subject selection is the reason for this high mortality which was explained earlier.[27-29] In our study, we found the mortality was very high among the people who had consumed the OPC poison of more than 50 ml and it is similar to the study done by Tanveer Hassan Banday et al.[16] Apart from the quantity of OP compound poisoning the increase number of days of atropinisation, increase in the duration of mechanical ventilation and reduced levels of serum cholinesterase levels were found to be the contributing factors for mortality in our study. In a study done by Murat S et al. found 50 % mortality among patients requiring mechanical ventilation for more than 4 days and a study done by Ahmed et al. showed 37 % mortality among patients on mechanical ventilation for more than 7 days.[30,31] Madala P et al. and Basu et al. have mentioned increased use of atropine for more number of days had a detrimental effect in the outcome of OPC poisoning patients.[32,33]

CONCLUSIONS

Mortality among OPC poisoning patients who were on mechanical ventilation was found to be very high and the factors influencing the mortality were the type of OPC compound, quantity of the compound consumed, lower level of serum cholinesterase, increase in the number of days of atropinisation and increase in the number of days on mechanical ventilation. Early resuscitation of patients with OPC poisoning might reduce the morbidity and mortality; prompt referral to tertiary care centres is warranted in these types of poisoning as a life saving measure.

The uniqueness of the present study is measuring of the outcome only among patients who were on mechanical ventilation.

Limitations

We have not measured the cholinesterase level during the final outcome and pralidoxime (PAM) use was not considered while analysing the results.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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