

Organophosphate Poisoning Predicting the Need for Mechanical Ventilator Support

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Abstract

Background: The easy availability and lack of legal strictures have made organophosphorus compound poisoning the deadly bane for the people of the lower socioeconomic strata, i.e., farmers and laborers. This study was conducted to predict the need for ventilator support in organophosphate poisoning and to identify the factors which help in predicting the need for ventilatory support in organophosphorus compound poisoning.

Materials and Methods: A total of 100 consecutive patients presenting with organophosphate poisoning admitted to New Civil Hospital, Surat, from September 2014 to October 2015 are studied. A provisional diagnosis of organophosphorus poisoning was made on the basis of a definite history of organophosphorus poisoning by patient or attendants and 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 and serum cholinesterase level and analyzed using proper statistical test, i.e., Chi-square test.

Results: With regard to grading of poisoning and its correlation of symptoms, 67% were of mild grade, 19% were of moderate grade, and 14% were of severe grade. Respiratory failure was the most common complication which may develop with 24 h after exposure. Only 2 out of 67 patients required ventilatory support with mild poisoning, 4 out of 19 patients with moderate poisoning required ventilator support, and 8 out of 14 patients with severe poisoning required ventilator support with significant ($P > 0.001$) association between severity by grading system and need of ventilation.

Conclusions: A grading system is developed to assess the patients at the time of admission so as to grade the severity of poisoning and deciding requirement of assisted ventilation and thereafter intensive care unit stay is to be decided. Ventilators are boon to patients with respiratory failure due to poisoning and decrease the mortality secondary to organophosphorus related respiratory failure.

Key words: Fasciculations, Mechanical ventilation, Organophosphate

INTRODUCTION

India is predominantly an agricultural country hence pesticides and insecticides are used abundantly during cultivation. Thus, it being natural to have access to this chemical substance by human beings, the contact or usage of these compound may either be accidental or suicidal and rarely homicidal.¹⁻⁹

Organophosphate poisoning is an ever increasing and troublesome situation in the developing countries and is a major health care challenge in the 21st century. Hence, this study has been conducted with special interest to ventilatory support in the treatment of organophosphorus poisoning, since the leading cause of death in organophosphorus poisoning is respiratory failure.¹⁰⁻²¹

Organophosphates are extremely toxic chemicals which present with a myriad of clinical problems all of which lead to difficulties in determining management. The organophosphates are an extremely toxic group of compounds which are rapidly absorbed by the dermal and oral routes. The following significant exposure symptoms of toxicity generally occur within 4 h.²²⁻²⁶

Access this article online



www.ijss-sn.com

Month of Submission : 07-2016

Month of Peer Review : 08-2016

Month of Acceptance : 09-2016

Month of Publishing : 09-2016

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The exception to this is extremely lipid soluble organophosphate (e.g., fenthion and dichlofenthion) which are rapidly taken into fat stores and subsequently slowly and intermittently released and metabolized to more active compounds. In this situation, the symptoms of toxicity may not occur for up to 48 h. The easy availability and lack of legal strictures have made organophosphorus compound poisoning the deadly bane for the people of the lower socioeconomic strata, i.e., farmers and laborers.²⁷⁻⁴¹

Purpose

1. To predict the need for ventilator support in organophosphate poisoning
2. To study the clinical profile of organophosphate compound poisoning
3. To identify the factors which help in predicting the need for ventilatory support in organophosphorous compound poisoning.

MATERIALS AND METHODS

A total of 100 consecutive patients presenting with organophosphate poisoning admitted to New Civil Hospital, Surat, from September 2014 to October 2015 are studied.

Sample Size

Hospital statistics has shown that about 130 cases of organophosphate poisoning in a year are admitted to New Civil Hospital, Surat. Hence, all the cases with inclusive and exclusive criteria are selected during September 2014 to October 2015.

Method of Collection of Data

About 100 consecutive patients presenting with organophosphate poisoning were included in the study.

Inclusion Criteria

A provisional diagnosis of organophosphorus poisoning was made on the basis of a definite history of organophosphorus poisoning by patient or attendants. This was substantiated by examination of the container (which was available in over 50% cases), when available. The diagnosis was further substantiated by typical clinical features (hypersalivation, miosis, and fasciculations) and characteristic odor of stomach wash or vomitus and serum cholinesterase level.

Exclusion Criteria

The patients with a concomitant illness or condition likely to accentuate the respiratory failure due to organophosphorus poisoning were excluded from the study. These included:

1. Patients with double poisoning with opioids, diazepam, and barbiturates

2. Patients with chronic lung disease, e.g., chronic obstructive pulmonary disease, extensive pulmonary tuberculosis, interstitial lung disease bronchiectasis, and bronchial asthma
3. Patients with chronic cardiac disease
4. Patients with known neuromuscular disease such as myasthenia gravis or muscular dystrophy.

Statistics

Data will be analyzed by,

1. Diagrammatic presentation
2. Mean \pm standard deviation
3. Using proper statistical test, i.e., Chi-square test.

Research Hypothesis

The ventilator support in organophosphorus poisoning patients decreases the mortality secondary to organophosphorus related respiratory failure.

RESULTS

Of 60 patients with Glasgow Coma (GC) Scale between 11 and 15, 0 required assisted ventilation, 32 patients with GC Scale between 7, and 10.6 (19%) required ventilation, whereas 8 patients with GC Scale between 3 and 6, 8 (100%) required assisted ventilation. This association between GC scale and need of ventilation is highly sensitive with $P = 0.0000001$ (Figure 1 and Table 1).

Of 28 patients with pinpoint pupils at admissions 13(46%) required ventilations (Table 2). This associations between pupil size and need of ventilation is highly significant (p value 0.0000001).

Patients with high fasciculation score required assisted ventilation more frequently when compared to patients with absent or only localized fasciculations (Table 3).

Most of the cases categorized for grading, 67% were in mild category, 19% in moderate, and 14% in severe poisoning at the time of admission (Table 4). Among 14 patients of poisoning which graded severe, 8 patients (57.14%) were intubated and put on ventilator. From 19 patients of moderate and 67 patients of mild poisoning, 4 (21.05%) patients and 2 (2.98%) patients required ventilation, respectively. Hence, the association between severe grade of poisoning and need of ventilation is highly significant with $P = 0.0000461$.

DISCUSSION

Of the various agents used for suicidal attempts in India, organophosphorus compound forms a significant group.

Table 1: Effect of sensorium on need for ventilatory support

GC scale	Number of patients ventilated	Number of patients non-ventilated	Number of patients
3-6	8	0	8
7-10	6	26	32
11-15	0	60	60
		8	

$P=0.0000001$, highly significant, Chi-square test - 59.51. GC scale: Glasgow Coma scale

Table 2: Effect of pupillary size on need for ventilatory support

Pupil	Number of patients ventilated	Number of patients non-ventilated	Number of patients
Pin point	13	15	28
<1 mm	1	28	29
2-3 mm	0	40	40
4 mm	0	3	3

$P=0.00000018$, highly significant, Chi-square test - 34.14.

Table 3: Presence of fasciculations and need for ventilatory support

Fasciculation	Number of patients ventilated	Number of patients non-ventilated	Number of patients
<2+	0	45	45
2-4+	1	35	36
>4+	13	6	19

$P<0.000001$, highly significant, Chi-square - 57.83

Table 4: Requirement of ventilatory support in relation to severity of organophosphorus poisoning

Grading	Non-ventilated	Ventilated	Total
Mild	65	2	67
Moderate	15	4	19
Severe	06	8	14

$P=0.0000461$, highly significant, Chi-square test - 1.53

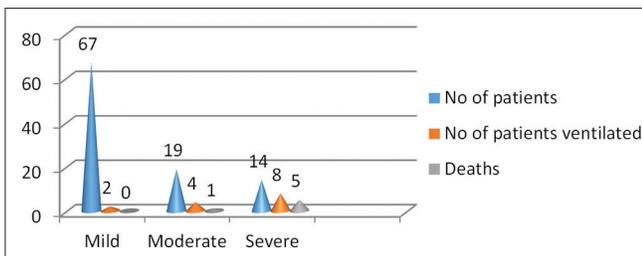


Figure 1: Requirement of ventilator support in relation to severity of organophosphorus poisoning

This is peculiar to developing countries like India, in developed countries 80% of suicidal poisoning result from intake of sedatives, antidepressants, and other related agents.³⁸

Organophosphorus insecticides are highly toxic to humans. Poisoning due to organophosphorus insecticides is steadily increasing in India. These pesticides are preferred for the purpose of suicide due to their easy availability and potent toxicity.

In a series of 312 cases of acute poisoning reported in Singh *et al.* (1984),⁴⁶ organophosphorus compounds were recorded as the poisons used for suicidal purpose in 19.23% of cases. Diazinon seems to be the choice in the majority of cases. Goel *et al.* reported 28% of cases of poisoning over 1½ years period resulted from organophosphorus compound.

Our study shows, 56% of cases of organophosphorus poisoning over span of 20 months in this institution which is referral hospital. The difference may be due to the fact that their study population was different from this study also in different in part of the country.

The peak incidence of suicide as reported by Quinby (1968),⁴⁰ Balani *et al.* (1968),⁴¹ Gupta and Patel (1965)⁴² was in the third decade of life followed by second decade, whereas incidences described by Vishwanathan and Shrinivasan 1962⁴³ was similar in both decades. Goel *et al.*⁴⁴ reported an incidence of 86.4% of cases including second and third decade. In our study, peak incidence of 73% was in 15-35 years age group. The age group 15-35 years is the most critical period, this is when one likely to phase various problems that may lead to psychological stress and ultimately force a person to take drastic steps to end his life by consuming available poisons.

In this study, female dominate to attempt suicide than males. Vishwanathan and Shrinivasan (1962)⁴³ reported higher number of suicidal cases among female than males. While, Mutalik *et al.* (1962),⁴⁵ Gupta and Patel (1968),⁴² Balani *et al.* (1968),⁴¹ and Goel *et al.* (1998)⁴⁴ reported higher number of males patients.

The female predominance in the study indicates the easier accessibility of organophosphorus compound to them. The majority of cases were in the age group 15-35 years.

The organophosphorus compound was consumed by 96% of case with intention to commit suicide. Occupational exposure was the source in 2%. Goel *et al.*⁴⁴ reported similar findings. Whereas, Quinby (1964)⁴⁰ reported that 50% of cases resulted from occupational exposure and 4.6% were of intentional suicide.

Among the organophosphorus compounds, diazinon was the choice in the study reported by Singh *et al.*⁴⁶ Tick - 20 (2% fenitrothion) was of choice in the study reported

by Agarwal monocrotophos and organophosphorus compound of choice in study by Goel *et al.* In our study, dimethoate was commonly used (34%).

Ventilatory support requirement specially with dimethoate was more in the present study which is similar to Goel *et al.*⁴⁴ study.

The fact that 96% cases were suicidal in our study group, it is in sharp contrast to figures reported from developed nations like Japan, where accidental occupational exposure forms bulk of organophosphorus cases.³⁹ The proportion of organophosphorus poisoning resulting from occupational exposure may be misreported to be low from developing world because such cases may not always seek medical attention, as a result of mild atypical symptomatology.⁴⁷

Clinically vomiting, pain abdomen, altered sensorium, hypersalivation, and breathlessness were common symptoms in this study. One patient had convulsions in our study compared to Goel *et al.*⁴⁴ who reported 6.7%.

Clinical science such as miosis, pungent odor, tachycardia, signs of respiratory insufficiency, fasciculations, and altered sensorium was common in our study. Mutalik *et al.* (1962),⁴⁵ Balani *et al.* (1968),⁴¹ Gupta and Patel (1968),⁴² Agarwal (1991).³⁹ Goel *et al.*, 1998,⁴⁴ also observed similar clinical scenario in their study.

With regard to grading of poisoning and its correlation of symptoms, 67% were of mild grade, 19% were of moderate grade, and 14% were of severe grade.

Respiratory failure was the most common complication which may develop with 24 h after exposure.^{9-11,39,46-50} Early onset of respiratory failure is due to cholinergic over activity, whereas late onset respiratory failure has been attributed to respiratory infections.

Of the 14 patients who required ventilator support, 9 (64.29%) required it within first 24 h after exposure to organophosphorus compound.

Tsao *et al.* (1990)¹¹ reported 40.2% of patients developed respiratory failure of which 80.2% developed during 24 h after exposure.

Relationship between delay in institution of specific treatment and survival was found to be insignificant by Mutalik *et al.*⁴⁵ but Goel *et al.*⁴⁴ showed significant relationship between delay in treatment and requirement of ventilator support. This study also shows that 23 patients have time lag of 3 or more hours for initial treatment of which 4 (17%) required ventilator support.

Only 2 of 67 patients required ventilatory support with mild poisoning, 4 of 19 patients with moderate poisoning required ventilator support, and 8 of 14 patients with severe poisoning required ventilator support with a significant association between severity by grading system and need of ventilation.

CONCLUSION

Organophosphorus compounds are commonly used agents for suicidal purpose because of their easy availability.

Females are more vulnerable due to a lot of domestic and marital problems. These compounds are reversible inhibitors of cholinesterase.

The common mode of death is due to respiratory failure which requires assist ventilation; other symptoms commonly involved are cardiac and central nervous system.

A grading system is developed to assess the patients at the time of admission so as to grade the severity of poisoning and deciding requirement of assisted ventilation and thereafter intensive care unit stay is to be decided.

Ventilators are boon to patients with respiratory failure due to poisoning and decrease the mortality secondary to organophosphorus related respiratory failure.

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How to cite this article: Soni P, Solu MG, Garg V, Pathria A, Shah S, Mundra A. Organophosphate Poisoning Predicting the Need for Mechanical Ventilator Support. *Int J Sci Stud* 2016;4(6):168-172

Source of Support: Nil, **Conflict of Interest:** None declared.