

Organophosphate Poisoning: A Retrospective Study of 50 Cases at J. L. N. Medical College, Ajmer, India

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Abstract

Our Study was aimed to analyse the pattern, the other demographic factors of medicolegal significance along with clinical prognosis of organophosphorus poisoning in Central Rajasthan (Ajmer) region. 50 patients were included in our study that were admitted in the emergency ward and diagnosed and labelled as Organophosphate Poisoning in case sheet during the period of April 2015 to July 2015. Majority of cases were from rural background (66%), with the most cases belonging to age group 21 to 30 years (40%). The Mortality rate was 12%. Organophosphorus Poisoning has high incidence along with mortality in this region. The Organophosphorus compounds are easily approachable to general public. Today's pattern of life leads to Organophosphorus compounds as a common poison to commit suicide. Accidental Exposure among the individuals handling and spraying insecticide in the field was common due to inadequate education and preventive measures.

Keywords: Organophosphorus, Poisoning, Sociodemographic, Profile.

Introduction

Poisonous substance, which if introduced in living body, or brought into contact with any part thereof, will produce ill-health or death¹. There is a substantial growth in the sector of industries, medicine and agriculture so that a significant number of new compounds have appeared as new poisonous substance. Organophosphorus compounds retard the enzyme activity of both cholinesterase and pseudo-cholinesterase and produce significant pesticide related illnesses and death.

Acute Organophosphorus compound poisoning is a life threatening condition, and most of those victims affected, required to be treated as an indoor case². The Organophosphorus compounds play role in suicidal, accidental and homicidal type of poisoning cases. Out of them because of easy availability, its cost effectiveness and rapid lethality even in small doses makes Organophosphorus compounds favourable for suicidal poisoning. The mode of entry in the body for producing symptoms of poisoning is from all the routes (i.e. ingestion, inhalation, direct application, injection). Accidental Organophosphorus poisoning may occur either through inhalation while spraying insecticide on crops or by improper handling with Organophosphorus compounds.

Organophosphorus compounds poisoning cases have a significant bulk in casualty wards even though little research has been done to evaluate victim's profile and factors affecting mortality in Rajasthan. Therefore we are aiming to analyse the medicolegal significance of Organophosphorus poisoning that includes its pattern, demographic factors of medicolegal significance along with clinical prognosis.

Compounds: Schrader developed Organophosphorus compounds just prior to World War II. The tetraethyl pyrophosphate (TEPP) was first recognized Organophosphorus compound. The tetraethyl pyrophosphate (TEPP) initially used as insecticide and later on used as warfare agent. The Organophosphorus compounds which are highly potent and toxic such as tabun, sarin, and soman are being used as Nerve gas compounds later to it. The Organophosphorus compounds are made up of esters, thiol esters, or acid anhydride derivatives of phosphorus containing acids in which majority are belonging to dimethyl phosphoryl or diethyl phosphoryl compounds³.

Table-1

Example of dimethyl and diethyl phosphoryl compounds are as follows

Diethyl OP Compounds	Dimethyl OP Compounds
Parathion	Dichloroovas
Diazinon	Dimethoate
Chlorpyrifos	Malathion
Dichlorfenthion	Fenthion
Coumaphos	Fenitrothion

Mode of Action: The OP compound irreversibly inhibits action of acetylcholinesterase by phosphorylation of the active site of

the enzyme that leads to accumulation of acetylcholine in the synaptic gutter and subsequently leads to persistent activation of cholinergic receptors at the post synaptic level, the autonomic and central nervous systems. The structure of the OP compounds has effect on its capability of rate and degree of AChE inhibition. The pure ion compounds don't significantly inhibit AChE in their original form and get activated by metabolic oxidation in vivo to Oxon form which further act as a more potent inhibitor. e.g., parathion is metabolized to paraxon in the body and become more potent inhibitor.

After the inhibition and formation of AChE- OP complex, it's fate now can be divided into two types: i. After inhibition, there is Spontaneous reactivation of the enzyme occurs but at a slower rate which may requires hours to days. The reactivation period for dimethyl OP- AChE is 7 hours and for diethyl OP- AChE it will requires ~31 hours. The spontaneous reactivation can be hastened by adding nucleophilic reagents like oximes, which liberates more active enzymes. So Oximes can be used as an antidote in OP poisoning⁴.

ii. The other change may occur to OP- AChE complex by losing on ealkyl group; it is no longer responsive to reactivating agents now. This time dependent process is also called as ageing. This process is affected by various factors like pH, temperature, and type of OP compound. The process of ageing requires half-life of ~3.7 hours for dimethyl OP-AChE where as it is ~33 hours for diethyl OP-AChE^{5,6}.

The OP Compounds which are having slow reactivation time are more prone to ageing process. Now applying these facts, the ageing process will be more rapid with dimethyl OPs, the reactivating agent like oximes are supposed to be useful if given within after 12 hours of OP poisoning⁴. However, in diethyl OP poisoning it may be helpful if given to the victim after many days of OP poisoning.

The carbamates have different pattern of toxic action but on the same enzyme. They reversibly inhibits the AChE and are used as medicines (neostigmine, pyridostigmine) as well as insecticides (carbaryl)⁷.

Intermediate syndrome: This is a specified clinical presentation that usually seen between 2 to 4 days after the consumption of an OP poison. The clinical picture appears after an initial cholinergic crisis but before the onset of delayed polyneuropathy⁸. About 10-40% of cases may show this type of presentation that includes weakness of muscles specially muscles of flexor group, muscles of neck, respiration and proximal limb muscles (the patient remains unable to raise head from pillow) this type of presentation seen in almost all type of OP Compounds but pronounced features seen in poisoning with fenthion, dimethoate and monocrotophos. The muscle weakness may last upto 5-14 days. An adequate respiratory support plays important role in the prognosis of this condition. This is interesting that exact pathogenesis for intermediate syndrome

still not clear but supposed to be due to persistent inhibition of AChE which leads to functional paralysis of neuromuscular transmission, muscle necrosis and oxidative free radical damage to the receptors⁹.

Materials and Methods

There were 50 patients included in our study, who were admitted in the Casualty Deptt. of J.L.N. Medical College and Hospital, Ajmer during the period from April 2015 to July 2015 and were subsequently diagnosed and labelled as Organophosphate Poisoning in case sheet. The case selection was based on the diagnosis recorded in the case sheet which was further relied upon the history narrated by the patient or from the patient's relatives regarding to the agent involved in the exposure and corroborated with clinical signs and symptoms of the victim as observed by treating doctor. In selected few cases (4%), the serum pseudo cholinesterase levels were evaluated to confirm the diagnosis and to aid in management of patients. In few cases (8%) where the initial history given by patients relative or by patient in the case sheet found misleading about the mode of exposure of OP agent we arbitrarily place them in suicidal mode of exposure, which were having fasciculation and crepts (crackling) sounds over the chest based on the clinical sign.

Results and Discussion

In current study out of 50 OP poisoning cases, 35(70%) were males and 15 (30%) were females with Male to Female Ratio observed was 2.33:1. Most of the cases were from rural areas (66%) in our study. The maximum number of cases (40%) were from the age group 21 -30 years.

The commonest route of poisoning was oral route in the suicidal cases and both oral and inhalational route of OP poisoning seen in Accidental cases. The most common sign observed among the victims of OP Poisoning was meiosis followed by altered mental status, hypersalivation and fasciculations as per sign and symptoms recorded in the case sheets. The symptoms of Intermediate syndrome were found in 9(18%) patients. The various Complications of OP compound consumption were observed in 19 (38%) patients. These complications were ranging from respiratory manifestations requiring mechanical ventilation (8 patients), Aspiration pneumonia (3 patients), Urinary system infection (4 patients), convulsion (3 patients) to septic shock (1 patient). The mean time of hospitalisation of victim was observed 5.1 ± 3.8 days with an average stay of 5.12 days. The mortality rate among victims of OP Poisoning in the present study was found to be 12% (6 cases) and these may be attributed to the reason that most of the patients were from rural background, delay in reaching to the hospital, their ignorance and fear of legal action lead to initial history of exposure to poisonous agent was misleading and posed a problem in diagnosis and management.

Table-1
Distribution of cases (Sex)

Category	No. of Cases	Percentage%
Male	35	70%
Female	15	30%

Table-2
Marital Status of Females

Category	No. of cases
Married females	9(18%)
Unmarried females	6(12%)

Table-3
Distribution of cases (Domicile)

Domicile	No. of Cases	Percentage%
Rural	33	66%
Urban	17	34%

Discussion: India is predominantly an agriculture based economy. In Indian scenario OP Poisoning is common in rural community as these compounds are like Over the Counter (OTC) Drugs which are available to people on affordable price.

Maximum number of the victims were from age group of 21-30 years (in present study it was 40%), which is consonance to that in other studies like Dash et al² and Sahin et al¹⁰. This younger

age group remains most active one physically, mentally and socially and so it was more prone to stress in their life. The other factors which may play crucial role in exposure to these agents in this age group may be family problems, break-up in affairs, unemployment, failure in examination, nuclear family concept, improper knowledge regarding pesticides. The three cases which were seen under the age of 10 years in this study were accidental.

Table-4
Distribution of cases (age wise)

Age Groups (in years)	No. of cases	Percentage%
0-10	3	6%
11-20	2	4%
21-30	20	40%
31-40	12	24%
41-50	11	22%
51-60	2	4%

Table-5
Distribution of cases (Mode of Exposure)

Mode of Exposure	Percentage%
Suicidal	68%
Accidental	32%
Homicidal	0%

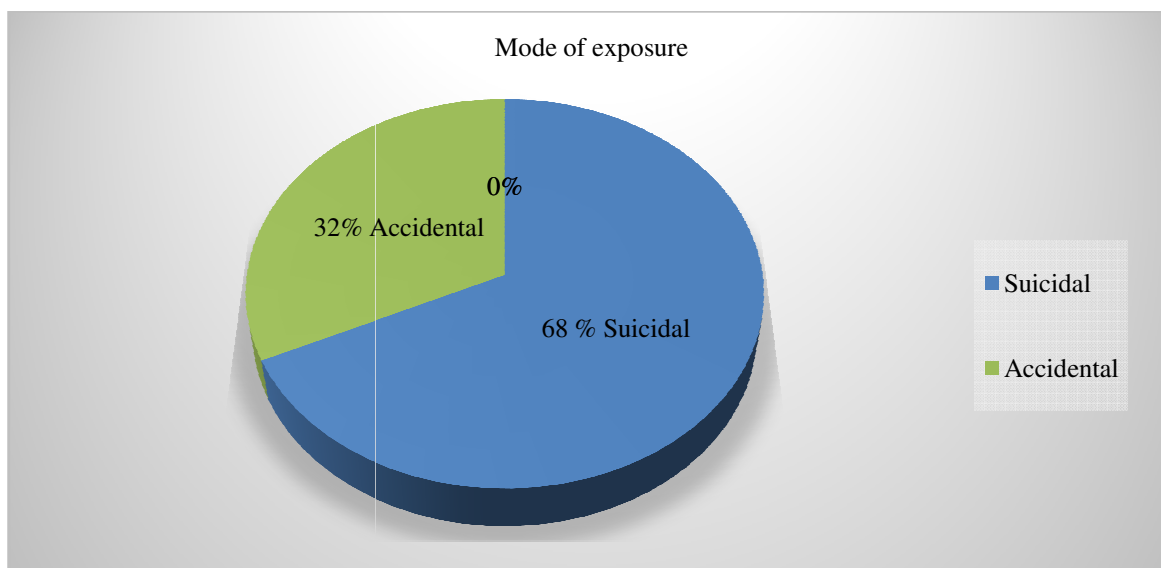


Figure-1
Pie Diagram showing mode of exposure

Most of the studies from India², Siwach et al¹¹, Gupta B.D. et al.¹² and from other countries Nepal¹³ and Western Australia¹⁴ showed that OP Compounds were implicated as agent for most of suicidal incidences (in present study it was 68%) followed by their accidental consumption.

The substantial reasons for the suicides in male group may be due to unemployment and other factors of day to day life leading to stress and depression. Incidence of OP poisoning was more in males (70%) in our study which was similar to Dhaval et al study¹⁵. The approximate similar findings were also observed in studies conducted at Manipal¹⁶, Allahabad¹⁷, Rohtak¹¹, and SriLanka¹⁸. However the incidence of OP Poisoning in females may be because of depression and marital conflicts.

Among various OP Compounds, the most commonly used agent was dimethoate (Rogar) as observed by the author in current study, followed by Chlorpyrifos which was in contrast to Banerjee et al study¹⁹ in which Methyl parathion was the most common agent found.

The married females were outnumbered the unmarried females in the present study, which is due to stress developed on individual after marriage related to different situations, rituals and customs and failure to cope up with them may possibly lead to this life endangering condition.

The average hospitalization time of patient was 5.12 days, which was similar to that found in other studies Kora S.A. et al.²⁰ and Karki P. et al.²¹.

In current study, mortality rate among OP Poisoning victims was 12%, which correlated with the Somasundaram K.V. et al study conducted in Maharashtra²². The mortality rate in India is ranges from 10- 30%. The mortality in one study of southern India conducted by Kora SA et al 2011 was 4.72% while in another study conducted at Rohtak, Haryana it was 47%, because in that study, the treatment was delayed due to various reasons.

Conclusion

In our study poisoning was common among the productive age group (21-30 years) which contributes to major fraction of socioeconomic development of the country.

Poison prevention strategies can be implemented at various levels as follows: The Pesticide Act should be strictly followed as the rules and regulations are framed regarding their synthesis by the manufacturer till their use in the fields by the farmers and their relatives. People who handle them, sell them, all should be under the supervision and proper monitoring by the concerned authority.

The Primary health Centre should be upgraded and developed with better infrastructure to provide immediate effective

treatment to poisoning specially to manage the cases of OP poisoning in an emergency.

Educating NGO's, village head and other volunteers about the first aid treatment of poisoning at household level.

Persons with psychosocial problems should be identified at the earliest and should be referred for psychiatric counseling.

Educating people through drug awareness programs, promoting poison information centers, specially designed programs for farmers to aware them and learning appropriate spraying techniques for OP insecticide

Further research is needed to introduce safer pesticides with minimal harm to the humans.

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