

Factors of Organo-phosphorus compounds Toxicity related Deaths: An Autopsy based Cross-sectional study

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ABSTRACT

Background: Organophosphorus compounds (OPCs) are chemical compounds that are used in pest control due to their low cost and easy availability. This boon is becoming a curse due to the fact that they are significantly contributing to poison related deaths. In this study, various parameters associated with organophosphorus compound deaths were analysed to further aid in prevention of more such fatalities.

Material and methods: A 12 month retrospective study was carried out at Bangalore, Karnataka by analyzing the postmortem findings, FSL reports, and relevant case history and police records. Among 445 poisoning cases in the year 2012, 175 were organophosphorus poisoning cases.

Results& Conclusion:The majority of the victims were illiterate (55%) and married (73%). In most of the cases victims consumed organophosphorus compound which was unidentified (48%) followed by methyl parathion (38%), dichlorvos (6%) and malathion (4%). Majority of the cases were male (76%). 79% of the victims received treatment. Maximum number of deaths was suicidal origin amounting to 94% of cases followed by accidental deaths (6%). Parental monitoring may prevent accidental deaths among pediatric age group. This study tried to identify the factors related to the fatal outcome of the OPC related deaths, so that appropriate preventive measures for OPCs related mortalities may be derived.

Keywords: organophosphorus poisoning; insecticide; case history; suicidal; mortality; health education.

INTRODUCTION

Organophosphorus compounds and carbamates are the two groups of cholinesterase inhibiting insecticides that commonly produce human toxicity. In the present era of increasing poison deaths, fatalities due to Organophosphorus compounds are common. As per WHO survey report, every year 3 million people are exposed to acute poisoning leading to 2,20,000 deaths throughout the year. Out of these, 90% cases belongs to the developing countries especially seen among the agricultural workers¹. The WHO reports that pesticides are now the most commonest method of suicide worldwide². An estimated 3000 to 6000 ventilators are constantly required in Asia alone to provide mechanical ventilation to poisoned patients³. Banning of the most toxic organic phosphorus insecticides has resulted in a 50% decrease in total suicides in Sri Lanka showing that governmental regulation can be effective⁴. Acetylcholine is secreted by neurons in many areas of the brain but specifically in the motor cortex and basal ganglia⁵. Organophosphorus compound is a highly toxic compound and acts by

inhibiting the enzyme cholinesterase which results in accumulation of acetyl choline at synapses and myoneural junction leading to cholinergic over-activity. Although the term “organophosphate” is often used in clinical practice and in the literature to refer to all phosphorus containing insecticides that inhibit cholinesterase, phosphates are compounds in which the P atom is surrounded by four O atoms and there are other derivatives of phosphoric and phosphonic acids such as phosphonates that can exhibit cholinesterase inhibition⁶.

Organophosphorus compounds can be classified into :

1. Extremely toxic (LD50: 1 to 50mg/kg) or highly toxic (LD50: 51 to 500 mg/kg)- Chlorpyrifos, Diazinon, Dichlorvos, Dimethoate, Fenitrothion etc.
2. Moderately toxic (LD50: 501 to 5000 mg/kg) or slightly toxic (LD50: more than 5000mg/kg) – Acephate, Malathion, Temephos, Triazo-phos etc⁷. Organophosphorus compounds also vary by

lipid solubility⁸, rate of activation, rate of AChE inhibition⁹ and relative inhibition of the plasma butyryl cholinesterase. Owing to their lethality and easy availability they are being used more and more. Therefore, it is highly essential for a forensic pathologist to understand about the different types of organophosphorous compounds, their toxic effects on humans and associated clinical features.

MATERIALS AND METHODS

The present study is an autopsy based cross-section study conducted in our Medical College Hospital at Bangalore, Karnataka. This study included all autopsy cases with an history of death due to alleged organophosphorus compound poisoning, registered during a year starting from January 2012 up to end of December 2012. Other than autopsy findings, the data also collected from viscera analysis reports of Forensic science laboratory, case-sheet findings along with the history collected from the attendants of the deceased, relatives, and the accompanying police records. Rest all types of autopsies, decomposed bodies were excluded from the study. The data obtained from the study was analyzed statistically by presenting data in the form of appropriate tables and figures, computing descriptive statistics. Microsoft Word and Excel version 2013 has been used for Statistical analysis of the percentages. Institutional ethical clearance has been obtained as per the prescribed norms of the institution and as applicable to our study.

RESULTS

In this study period, 3806 autopsies were conducted. Out of these 445 (11.69%) were poison related deaths. Among these poison related deaths, 175 (39.32%) deaths were due to Organophosphorous compounds. In total, Organophosphorous compound poisoning constituted 4.59% of all deaths. The age of the deceased varied from 10 - 80 years. 21–30 age group formed the majority among the victims which was also observed in the study conducted by S. Peranatham et al.¹⁰ and Kar et al.¹¹. Suicide was the most common manner of death. Similar observations were made by S.C Joshi et al¹². Males constituted 76% of the cases, females constituted 23.4% of cases, one case being transgender. 56% of the study group belonged to the lower class which was also

observed in the study conducted by S.C Joshi et al¹². The majority of the victims were illiterate (55%) and 45% were literate. Majority were married (73%) and 27% were unmarried victims. In majority of the cases (48%) victims consumed organophosphorous compound which was unidentified. 79% (138 cases) of the victims received treatment whereas 21% (37 cases) did not receive any treatment. Ill health (41%) was the most common cause for suicide followed by depression (36%), followed by marital problems, financial problems and unknown causes. This was in contrast to the observation made by Dharal J Patel and Pawan R Tekade¹³ where financial problems were common among males and domestic problems were common among females.

DISCUSSION

Organophosphates are powerful inhibitors of acetylcholinesterase which is responsible for hydrolysing acetyl choline to choline and acetic acid. They bind to the acetylcholinesterase molecule at the active site and phosphorylate the serine moiety. The phosphorylated enzymes make the acetylcholinesterase inactive and an alkyl group is lost from the conjugate⁷. Inhibition of AChE is generally thought to account for clinical features of organophosphorus compounds. However, many other enzymes are also inhibited like butyryl cholinesterase, plasma and hepatic carboxylesterases, paraoxonases, chymotrypsin and other non-specific proteases^[14]. Organophosphorus compounds are well absorbed from the lungs, gastrointestinal tract, mucous membranes and conjunctiva following inhalation, ingestion or topical contact¹⁵. The time to peak serum concentration after self-poisoning is unknown. Patients ingesting large amounts of fast acting organophosphorus compounds become symptomatic within minutes^{16,17} suggesting absorption can be rapid. The features of acute poisoning are cholinergic manifestations and central nervous system manifestations. The cholinergic manifestations are due to muscarinic effects such as bronchoconstriction, vomiting, diarrhoea, abdominal cramps, increased salivation, lacrimation and sweating, bradycardia, hypotension, miosis and urinary incontinence. Bronchorrhoea can be so profuse that it mimics pulmonary edema¹⁸. The nicotinic effects are fasciculations, weakness, hypertension, tachycardia and paralysis. The literature is filled with reports of organophosphorus compound associated QT

interval prolongation and ventricular dysrhythmias¹⁹. The central nervous system manifestations are restlessness, headache, drowsiness, delirium, slurred speech, ataxia and convulsions. Death results from respiratory failure. The main features of chronic poisoning are polyneuropathy - paraesthesia, muscle cramps, weakness, gait disorders and central nervous system effects are drowsiness, irritability, anxiety and psychiatric manifestations. Diagnosis of organophosphorous poisoning is by demonstration of Depression of cholinesterase activity, P-Nitrophenol test and Thin Layer Chromatography⁷. The postmortem appearances of death due to organophosphorous poisoning are characteristic kerosene-like odour, signs of asphyxia such as blood stained frothing at mouth and nose, cyanosis and congestion of face and constricted pupils. The internal findings are hemorrhagic pulmonary edema and congestion of the organs. There may be epicardial hemorrhages in the heart in victims who have survived for more than a day²⁰.

CONCLUSION

This study helps in assessing the various parameters associated with organophosphorus compound deaths such as socio-economic status of the deceased population, causative factors for their death, manner of death and treatment aspects of the deceased population. This plays a key role in preventing OP poisoning related mortalities in future if the concerned factors are taken care of. It also emphasizes the need for proper health education to farmers, industrial workers.

Limitations of the study: While conducting the autopsy, even though relevant information was provided by the police, close insight into some cases could not be obtained as the close family members of the deceased could not be interviewed due to their state of agony.

Conflict of interest :

declared none.

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