Impact of type of organophosphate insecticide compounds on outcome of acute poisoning

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Abstract

Organophosphate **(OPh)** pesticide remains the main agent for pest control. It is therefore likely to have adverse effects on farmers who are accidentally over exposed while handling these pesticides. It has also become an agent of choice for self- poisoning because of low cost and easy availability. **OPh** consumption accounts among the most cause of suicide in the world as 258,234 would die of organophosphate poisoning and they account for 30% of the suicidal cause worldwide. Accumulation of acetylcholine leads to cholinergic features; they can be broadly divided into central and peripheral symptoms. Vomiting, diarrhea, miosis muscle fasciculations, urinary incontinence and bronchoconstriction are the common muscarinic symptoms.

Keywords: Organophosphorous poisoning (**OPh**), OPIDP: Organophosphate- induced polyneuropathy.

Introduction

Organophosphate pesticides are the most common and widely used insecticides mainly in rural areas where the protocol of management is lacking and these results in high morbidity and mortality. There are approximately 200,000 persons per year die from organophosphate compounds exposure and according to a report done by World Health Organization (WHO) because they are available and very cheap and mortality rate exceeds nearly above 15% (Eddleston et al., 2004).

Acute organophosphate poisoning (OPh) occurs mainly due to accidental and intentional exposure. Its main mechanism of action is irreversible inhibition of the acetyl cholinesterase (AchE) enzyme resulting in accumulation of acetylcholine at cholinergic receptors with subsequently over stimulation of muscarinic and nicotinic receptors in the central and peripheral nervous system (Esen & Uysal, 2018).

The clinical picture of acute OPh poisoning presented as acute cholinergic crisis and some cases develop intermediate syndrome (IMS) and organophosphate –induced delayed polyneuropathy (OPIDP). Acute cholinergic crisis begins within 30 minutes of exposure up to 48h while IMS usually occurs after significant exposure within (24-96 hours) and finally OPIDP occurs within (2-3weeks) after poisoning (Joy et al., 2019).

History of exposure to one of OPh compounds (OPCs), characteristic clinical picture, confirmation by estimation of cholinesterase activity which will be inhibited more than 25% are the diagnostic tools in acute OPh poisoning and finally improvement of these manifestations with antidote therapy (Setiani et al., 2019).

OPh pesticides are the most common used insecticides especially after banning of organochlorine compounds mainly in rural or undeveloped areas of agricultural countries where the toxicity of the poison and the protocol of its management are lacking and this subsequently leads to high morbidity and mortality (Grandjean & Landrigan, 2006).

According to World Health Organization (WHO), there are one million cases per year diagnosed as acute OPh poisoning with mortality rate above 15%. Increased incidence in developing countries is also reported as there is above 250,000 deaths/year and this result due to OPh compounds are very cheap and available(Naik et al., 2019).

OPh compounds are phosphoric acid esters which widely used to control insects. The phosphorus atom is the central compound with a double bond either to sulfur (P=S) or oxygen (P=O) and three side chains X group, R1 and R2.Combination of R1 and R2 and leaving X group enables synthesis of various of derivatives characterized by different actions depending R1, R2 and X group as in fig (1). X group is the most important metabolite for identification of derivatives (Balali-Mood et al., 2012).

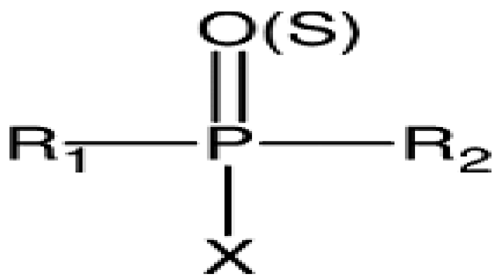

Fig. (1): General chemical structure of an organophosphorous compound (Quoted from Abubakar et al., 2020).

Classification of OPh compounds

OPh compounds can be classified according to chemical structure into two types: aryl phosphate (as parathion, paraxon and methyl parathion) and alkyl phosphate (as malathion, dimefox).They also classified according to WHO as in table (1) into: extremely toxic (Ia) as parathion, highly toxic (Ib) as fenamiphos, moderate toxicity (II) as malathion and slightly toxic (III) as diazinon (Yadav & Devi, 2017 and Nurulain et al., 2013).

They can be classified according to its lethal dose (LD) into: high toxic compounds with LD <50 mg/kg (as bomyl, phorate, demeton, isofluorphate and Methidathion), moderate toxicity with LD 50-1000mg/kg (as diazinon, Fenthion, merphos, cythioate dimethoate and bensulide) and low toxicity LD >1000mg/kg (as malathion, bromophos, temephos and phoxim) (Kumar et al., 2016).

Table (1): Important OPh pesticides and classification according to the WHO recommended classification of pesticides by hazard (International Program on Chemical Safety (Quoted from Worek et al., 2016).

OPh compound	**WHO** classification class
Parathion	(Ia)
Diazinon	(III)
Chlorpyrifos	(II)
Malathion	(II)
Dimethoate	(II)
Fenamiphos	(Ib)
profenofos	(II)
Methamidophos	(Ib)

Patients and methods

The current study is a clinical prospective study that was conducted on50 adult patients diagnosed as acute organophosphate insecticide poisoning who were admitted to Minia Poison Control Center (**MPCC**) to assess the impact of type of organophosphate (OPh) insecticide compounds on the outcome of acute poisoning

Patients:

Inclusion criteria:

The patients were selected from Minia Poison Control Center (MPCC), during the period from November, 1st, 2019 to October, 31th, 2020. A written consent of agreement was taken from the selected patients or from their families to participate in this study.

In this prospective study, the selected patients were adult patients with age group (18-60) years, both sexes and diagnosed as acute organophosphate poisoning. Detailed history, evidence of consumption and characteristic clinical manifestations should be included.

Exclusion criteria:

Patients with history of mixed poisoning with other substance other than **OPh** compounds were excluded to participate in this study.

Results

The current study was carried out on fifty patients with organophosphate poisoning who had been admitted to the Poison Control Center of Minia University Hospital during the period from the November, 1st, 2019 to October, 31th, 2020.

Sociodemographic variables:

The baseline characteristics of the studied individuals were summarized as following:

Age: ranged between 18 to 50 years with a mean and SD of 26.3 ± 6.8 years.

Table (2): Showing age of the patients

Age	
Range **(Mean ± SD)**	(18-50) 26.3±6.8

SD: Standard deviation.

Compound: considering the type of ingested organophosphate compound, Malathion was found to be the most frequent one to cause poisoning in comparison to other agents with significant statistical difference as shown in table (2).

Table (2): Showing OP compounds ingested by patients

Compound	Percentage	*P*-value
• Malathion	36%	0.009*
• Diazinon	28%	
• Clorpyrifos	8%	
• Dimethoate	12%	
• Parathion	16%	

Chi square test for qualitative data
Independent Samples T test for parametric quantitative data
Significant P value < 0.05

		Recovered group N=32	Dead group N=18	P value
Compound	• Malathion	4(12.5%)	14(77.8%)	***<0.001****
	• Diazenon	11(34.4%)	3(16.7%)	
	• Chlorpyrifos	4(12.5%)	0(0%)	
	• Daimethoate	5(15.6%)	1(5.6%)	
	• Parathion	8(25%)	0(0%)	

Mann Whitney test for non-parametric quantitative data
Chi square test
Significant P value < 0.05

Discussion

Organophosphorus poisoning is the most important clinical and community problem now in developing popu-lations. The pesticides containing organo-phosphorus compounds are inexpensive and easy available and this result in misuse of them and increase suicidal attempts (Regmi, et al., 2020).

A prospective study of 50 acutely intoxicated adult patients with organo-phosphorus compounds were admitted to the Minia Poison Control Center (MPCC) throughout the period from November, 1st, 2019 to October, 31th, 2020. The selected patients were adults with age group (18-60) years, both sexes and diagnosed as acute OPP.

According to this study, there were four different organophosphorus compounds associated in the intoxication but the commonest one was the malathion. Hassan & Madboly also found in their studies in (2013) that malathion is the most OP compound involved in intoxication (46.7%). This refers to that the most common OP compounds used by farmers in Egypt are malathion and diazinon. In contrast to Laudari et al., study in (2014) which found that the chlropyrifos with Cypermethrin added is the commonest OP compound ingested.

This current study revealed that mala-thion ingestion was increased in the bad prognostic outcome and this in agree-ment with Kang et al., (2009) study that revealed increase mortality rate with cases with history of malathion ingestion.

On the other hand Sungur & Guven (2001) study that revealed that is no relation of ingestion of any OP compounds to the bad prognostic outcome.

Conclusion

Organophosphorus insecticides poisoning considers a severe condition and one of the most important causes of high morbidity and mortality in developing nations that requires rapid diagnosis and adequate treatment.

According this study, type of organophosphate compound was correlated with bad prognosis of acute poisoning.

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