

Death from zinc phosphide in Iraq: A documentary study based on medico-legal records at medico-legal directorate

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ABSTRACT

INTRODUCTION: Zinc phosphide is an inorganic chemical compound with rodenticidal activity. It is not uncommon cause of poisoning especially in developing countries. It has a high mortality rate but has no antidote so far. In Iraq the scope of this problem is not defined due to lack of studies in this respect.

OBJECTIVE: To study the incidence of death due to zinc phosphide poisoning in Iraq during the period from 2007-2014.

METHODS: A documentary study based on reviewing the records of cases of death due to zinc phosphide poisoning which were presented to the medico-legal directorate in Baghdad/ Iraq from January 2007-December 2015. Data were collected from the records with some demographic features of the victims like age and gender.

RESULTS: The incidence of death from zinc phosphide poisoning is progressively increased from 15 cases in 2007 to 35 cases in 2014. Women are involved more commonly than men 123:94 during the studied period. Young adults are the main age group involved with this medical problem.

CONCLUSION: Zinc phosphide poisoning is not uncommon problem in our country; it is increasing in number. Females are involved more commonly than males. Young adults are the main age group involved by this medical problem.

Key words: Zinc phosphide, poisoning, toxicity, rodenticide.

INTRODUCTION

Zinc phosphide is an inorganic, dark grey, and crystalline chemical compound.¹ It is used as a rodenticide or pesticide to control small mammals such as mice, rats, field mice, dogs, and squirrels.² It is a highly effective rodenticide usually mixed into food as rodent bait. In agricultural works, it is used widely to protect grain in stores and during transportation. When the rodent ingests the food the acidity of its stomach reacts with phosphide to generate the toxic phosphine gas.

Phosphide can be used in many forms. It may be combined with zinc, aluminium, calcium and magnesium; however, zinc is the commonly used combination due to its low price and easy availability.³

Despite all the precautions and warnings about their seriousness and toxicity, pesticides are still a major cause of acute poisoning in ag-

ricultural communities both intentionally and accidentally. Pesticide poisoning is not uncommon in communities especially of developing countries. A study in Egypt has reported that pesticide poisoning accounted for 14.3% of admitted cases to hospital.⁴ Zinc Phosphide poisoning represented about 20 % of the total cases of pesticidal toxicity just next to organo-phosphorus.⁵

Acute toxicity with zinc phosphide can occur either directly due to ingestion of phosphide salts or indirectly through inhalation of phosphine gas generated from its use.⁶

Mechanism of action: On mixing with water and acidity of the stomach zinc phosphide generates phosphine gas. Phosphine gas is rapidly absorbed from the bowel, and highly toxic and irritating to the respiratory system. In addition, it produces severe systemic toxicity. On a cellular level phosphine gas disrupts mitochondrial function through blockade of cytochrome C oxi-

dase, and production of free radicals.⁷

The lethal dose of phosphide is 500 mg; once it is ingested the symptoms will start within 30 minutes and death can occur within 6 hours.⁸

Ingestion of less amount of phosphide can cause:^{9,10,11}

1. Gastrointestinal symptoms: nausea, vomiting and abdominal pain.
2. Respiratory symptoms: tachypnea, dyspnea, cough, chest tightness, and non-cardiogenic pulmonary oedema
3. Cardiac symptoms: Tachycardia, hypotension and dysrhythmias. Phosphine-induced dysrhythmias include atrial fibrillation, flutter, heart block, and ventricular tachycardia and fibrillation
4. Neurologic symptoms: coma, seizures, and delirium
5. Renal: acute tubular damage
6. Liver: Hepatomegaly, raised transaminases, hepatic failure, severe hypoglycemia or severe metabolic acidosis.

There are no antidotes currently known for acute poisoning with zinc phosphide. The mortality rate of zinc phosphide poisoning is variable around 37–100 %.^{1, 12}

The scope of the problem in Iraq is unknown. We couldn't find any published article about phosphide poisoning in Iraq. This study was designed to find out the number of persons died because of phosphide poisoning in Iraq from 2007-2014.

METHODS

This is a documentary study conducted by reviewing all records at medico-legal directorate in Baghdad, Iraq from January 2007 to December 2014 to search for any case of death due to phosphide poisoning. Data were collected from January to March 2015.

Inclusion criteria: We enrolled all cases of death due to phosphide poisoning which were reported in the records of medico-legal directorate from January 2007 to December 2014.

Procedure: We reviewed all the records of cases of death due to phosphide poisoning in Iraq, and calculated the number of cases each year. In addition, we identified the distribution of cases between genders and among age groups.

The protocol used by the medico-legal directorate is to send all cases of death that were

presented for investigation to full toxicology profile including phosphide level. We usually send sample of blood, urine, gastric contents, scene residues and sometime 50 grams of liver for toxicology investigations. All cases included in this study were diagnosed chemically to have phosphide poisoning.

RESULTS

Table 1 summarizes the number of deaths due to acute poisoning of zinc phosphide with regards to some available demographic criteria.

DISCUSSION

This is a simple study aimed at detection of the number of persons who died due to acute phosphide poisoning. We couldn't find more clinical data in the records of these cases; however, lack of more pieces of information will not preclude us from highlighting this not uncommon cause of death. Hoping we can drive others to design more comprehensive study and include more clinical data in the future.

In our study we found that the number of persons died because of acute phosphide poisoning is progressively increased over the studied years; from 15 in 2007 to 35 in 2014. This raise can be explained by a real increase in the number of persons died due to phosphide poisoning in our community or due to the improvement of detection and registration of cases at medico-legal directorate. In Iraq, we didn't find figures about the scope of the problem of phosphide poisoning in emergency and in-hospital departments. Mathai from India¹¹ has reported 16 (59.3 %) deaths out of 27 patients diagnosed with acute poisoning of phosphide. While El-Naggar³ from Egypt reported much less incidence of death; only one (0.6%) out of 165 patients who were admitted to the hospital due to acute phosphide poisoning. This huge variation in mortality rate can be explained by the difference of the phosphide salts the patient had exposed to. The Indian study reported exposure to aluminium phosphide while the Egyptian study reported zinc phosphide. In Turkey, Gokdemir¹³ has reported death of 5 (19.2 %) persons from a total of 26 persons who had ingested zinc phosphide for suicidal attempts.

For the effect of gender, our study has showed that more women have died due to zinc phosphide poisoning than men 123:94 over the

Table 1: distribution of cases over years with some demographic criteria.

Year	Number of cases	Number of males	Number of females	Age average (years)	Age range (years)
2007	15	5	10	34.06	25-58
2008	20	13	7	33.05	3-63
2009	25	13	12	30.76	2-64
2010	27	14	13	29.05	16-70
2011	30	12	18	28.06	23-71
2012	32	12	20	27.46	25-72
2013	33	16	17	26.05	8-67
2014	35	9	26	30.77	25-66

studied years. In comparison with 2007, 2014 have showed that the percentage of death among women in proportionally increased than that among men from 10:5 to 26:9 respectively. Most of the studies agreed that women outweigh men in acute poisoning. In developing countries where people are still running a simple life, woman usually works at home and in agricultural land and this would expose her to many pharmaceutical products used for different purposes. Such difficult life for women and easy access to toxic substances might explain the tendency to find high rate of acute poisoning with zinc phosphide among women in some developing countries.^{14,15}

Our results are consistent with that from Turkey¹³ and Egypt,³ but two Indian studies have shown the reverse where number of men involved is more than women.^{11,14} This difference can be explained by the differences among cultures with respect to the exposure of women to this risk, effect of sampling, and the probable difference in the effect of different types of phosphide salts on gender.

In our study no age group was immuned against the danger of acute poisoning and even death from zinc phosphide during the studied period. Victims were ranging from as young as 2 years to as older as 72 years; however the average age group of involvement was between 26-34 years. Most of the studies^{3,11,13} have agreed that young age group are more prone for acute intoxication with phosphide.

Our study has many limitations; the first is that we couldn't find clinical history to know the presenting features of the intoxication and to calculate the case fatality rate from those exposed to the toxin, the second is that we did not find any data about whether the intoxication was intended or accidental and what are

the circumstances surrounding this issue; probably in Iraq this is the duty of the legal authority to judge rather than the medical authority. The last limitation was that our study is a retrospective one depending on records at the medico-legal directorate and it is better in the future to perform a prospective and more comprehensive study; on all exposed persons, in order to draw better conclusions about the scope of this problem in our country and to have a plan to prevent it.

CONCLUSIONS

Zinc phosphide is not uncommon cause of death in Iraq. It is increasing in number over the last 8 years. Females are involved more commonly than males. It is usually a problem of young adults.

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