

An Epidemiological Study on Acute Zinc Phosphide Poisoning in Nepal

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Abstract

Introduction	Zinc phosphide is a commonly used household rodenticide. Due to its widespread use and easy availability, suicidal poisoning by this rodenticide is correspondingly increasing.
Objectives	This study sought to analyze zinc phosphide poisoning calls to the Nepal Drug and Poison Information Center.
Methods	A retrospective study were carried out for all zinc phosphide poisoning calls to the Nepal Drug and Poison Information Center for five years from July 1997 to June 2002. There were 192 cases of which 178 were zinc phosphide alone. 14 cases were excluded from the study due to co-ingestants involved and for those patient who were lost on follow up; 9 of these cases involved ethanol in addition to zinc phosphide and 5 cases were lost on follow up.
Results	There were 119 females (67%) and 59 males (33%). Ages ranged from 2 years to 57 years with a mean of 22.66 years (± 11.85) and median of 21 years. Reasons of exposure were intentional self-poisoning (79%), unintentional (18%) and unknown (3%). 79%, 18% and 2% of patients on arrival to hospital emergency department were asymptomatic, mild and moderately ill respectively. The most frequent initial presenting sign was abdominal pain (62%), followed by vomiting (23%), dizziness (19%), and headache (13%). Ninety seven per cent of patients presented within first 3 hours post exposure. Correlation between severity grade and time to presentation was not found.
Conclusion	Most zinc phosphide exposure calls involved either asymptomatic or mild symptoms regardless of reason of exposure. Reduction of unnecessary hospital observation for asymptomatic patients is expected to save already over stretched public health resource. All intentional self-poisoning cases should be referred to psychiatric/psychological counseling.
Keywords	Zinc Phosphide, Poisoning, Nepal Drug and Poison Information Center (NDPIC)

Introduction

Suicide is an individual act with a greater social implication. The World Health Organization defines health as a state of complete physical and social well being and not merely the absence of disease or infirmity¹. In Nepal, suicide poisoning is a common means in both completed and attempted suicide. Zinc phosphide is commonly used household rodenticide. Due to its low cost and easy availability, it is emerging as a common self-poisoning agent in aduhas led to increase in number of poisoning cases in recent years due to this rodenticide². There have been limited studies on epidemiology of the specific group of poisons in Nepal. In this background, this study attempts to highlight the demographics, reason of exposure,

initial severity, clinical effects, and medical outcome due to zinc phosphide poisoning.

Methods

This is an uncontrolled retrospective case series for the five-year period from July 1997 to June 2002. A retrospective chart review was performed to locate all exposures due to zinc phosphide that were reported to the Nepal Drug and Poison Information Center. The specific information retrieved for the study included age, sex, marital and occupational status, religion, dose ingested, reason of exposure, route of exposure, concomitant ingestions, symptoms, vital signs, whether direct medical evaluation occur, treatment provided and medical outcome. Exclusion criteria were concomitant ingestants and patients who were lost on follow up.

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Results

There were 192 cases of which 178 were zinc phosphide alone. 14 cases were excluded from the study due to co-ingestants involved and those patient who were lost on follow up; 9 of these cases involved ethanol, and 5 cases were lost on follow up. The treating physician reported all cases. The study populations comprised of 119

(67%) females and 59 (33%) males. Ages ranged from 2 years to 57 years with a mean of 22.66 years (± 11.85) and median of 21 years; 57% (N=102) of the study subjects were married of which females (72%; N=73) outnumbered the males (28%; N=29); People of Hindu religion comprised of majority of cases 85% (N=151) followed by Buddhist 8% (N=15) as shown in table 1.

Table 1

Gender	Female: 119	Male: 59	
<u>Demographics</u>			
Age	Range: 2 years to 57 years	Mean: 22.66 years (± 11.85)	Median: 21 years
Age breakdown	29 Children (<12 years)	25 Adolescents (12 to 17 years)	124 Adults (> 18 years)
<u>Marital Status</u>			
Married	73	29	102 (57%)
Unmarried	31	20	51 (29%)
Widowed	5	0	5 (3%)
Divorced	3	6	9 (5%)
Unknown	7	4	11 (6%)
<u>Religion</u>			
Hindu	99	52	151 (85%)
Buddhist	10	5	15 (8%)
Muslim	6	1	7 (4%)
Christian	4	1	5 (3%)

In occupational status of the study populations (excluding 16 children who were under the age of 3 years), housewives topped the list with 35% (N=57)

followed by student 22% (N=36), unemployed 17% (N=27) and service holder 14% (N=23) (Table 2).

Table 2 Occupational status

	Female (N=111)	Male (N=51)	Total (%)
Housewife	57	---	57 (35%)
Student	21	15	36 (22%)
Unemployed	15	12	27 (17%)
Service	13	10	23 (14%)
Business	3	7	10 (6%)
Farmer	0	3	3 (2%)
Laborer	1	3	4 (3%)
Unknown	1	1	2 (1%)

Reasons of exposure were intentional self-poisoning (79%), unintentional (18%) and unknown (3%); and 79%, 18%, 2% and 1% of patients on arrival to

hospital emergency department were asymptomatic, Minor, Moderate, and Major symptomatic respectively as listed in Table 3.

Table 3

	Female (N=119)	Male (N=59)	Total (%)
<u>Reasons of exposure</u>			
Intentional	106	34	140 (79%)
Unintentional	12	20	32 (18%)
Unknown	1	5	6 (3%)
<u>Initial Severity during presentation</u>			
Asymptomatic	99	42	141 (79%)
Minor symptoms	17	15	32 (18%)
Moderate symptoms	2	2	4 (2%)
Major symptoms	1	0	1 (1%)

The most frequent initial presenting sign was abdominal pain (78%), followed by vomiting (35%), dizziness (24%), and headache (16%), and

their medical outcomes were no effect (79%), minor effect (18%), moderate effect (2%), major effect (0%), and death (1%) as listed in Table 4.

Table 4

	No. of patients (%)
Clinical Sign & Symptoms	
Abdominal pain	29 (78%)
Vomiting	13 (35%)
Dizziness	9 (24%)
Headache	6 (16%)
Medical outcomes	
No effect	141 (79%)
Minor effect	32 (18%)
Moderate effect	4 (2%)
Major effect	0 (0%)
Death	1 (1%)

Ninety seven per cent of patients presented within first 3 hours post exposure. Correlation between severity grade and time to presentation was not found. Seventy five per cent of the patients had undergone gastric lavage of which 92% received a dose of activated charcoal in addition. All patients were managed with symptomatic and supportive care.

Discussion

Zinc Phosphide is commonly available and used household rodenticide in Nepal. It is usually available in powder form. It has a dark gray color with rotten fish odor. In Nepal, it is available in different brand names viz *Zinc Phosphide*, *Ratol*, *Commando* etc. Due to its peculiar odor and taste, it is unattractive to other animals except rats. Ingestion is the most common route of exposure to this compound although inhalation of dust or absorption from broken skin also produce toxicity.

Oral LD₅₀ of zinc phosphide for rat is 12 mg/Kg and for cat and dog is 40 mg/Kg³. The emetic qualities of Zinc help to explain the lower toxicity of zinc phosphide to dog and cats⁴. In humans, death has been reported following 4 g ingestion although maximum tolerated dose reported is 50 g of zinc phosphide⁵.

Zinc phosphide liberates phosphine gas on contact with acid and water in the stomach. Phosphine is a colorless, flammable and poisonous gas used in many organic preparations: preparation of phosphonium halides; as a doping agent for semiconductors; a polymerization initiator; a condensation catalyst, and as a fumigant. The lowest concentration of a substance in air, other than LC₅₀, that has been reported to have caused death in humans and animals (LCLo) of phosphine in the human is 1000 ppm for 5 minutes³. The threshold limit value (TLV) is 0.3 ppm and symptom can occur at 10 ppm⁶.

The majority of patients with zinc phosphide poisoning in this case series were asymptomatic and despite the reason and amount of exposure ninety nine percent of patients had a favorable outcome except in 1 fatal case in which amount ingested was more than 20 g. Supportive care is the mainstay of therapy in zinc phosphide poisoning. Patients with altered mental status should receive dextrose, thiamine and naloxone.

Phosphine is a highly toxic poisonous gas which blocks cytochrome C oxidase enzyme and especially toxic to organs with high oxygen demand including the brain, kidney, heart, and liver³. The onset of symptoms is rapid and symptoms include nausea, fatigue, cough, dizziness, headache, lethargy, vomiting and sweating. Other serious symptoms include shock, metabolic acidosis, jaundice, hypoglycemia, renal failure, delayed onset pulmonary edema, convulsions and coma⁷⁻⁹.

Symptomatic and supportive care is the mainstay of therapy. Gastrointestinal decontamination is highly controversial. Some toxicology reference suggest induction of emesis within 30 minutes post ingestion^{5,6,9} and some do not³. Similarly controversies exist for administration of water mixed activated charcoal although studies have not shown clear benefit^{3,7,10}. Gastric lavage with water or 3-5% sodium bicarbonate (to reduce gastric acid and resulting production of phosphine)¹⁰ or 1:5000 potassium permanganate (to oxidize phosphine to less absorbable phosphide)⁶ has been advised but the efficacy hasn't been proven. Each of these decontamination techniques carries its own risks, and physician must be aware of these dangers before undertaking any decontamination measures. It is strongly recommended that in patients with significant zinc phosphide ingestion airway protection be performed prior to gastric lavage.

Zinc phosphide poisoned patients should be carefully evaluated with complete history and physical examination. NDPIC recommend not to perform gastric lavage in asymptomatic patients with less than 1 g of zinc phosphide ingestion but provider must be careful in calculating amount of ingestion especially in case of suicidal patient, who might provide incomplete history. If the patient remains asymptomatic with normal vital signs for 4-6 hours, then they may be discharged with the suggestion to return if symptoms of toxicity develop. Prior to discharge, patients must be evaluated by psychiatrist if the reason of exposure is intentional. In case of unintentional exposure to zinc phosphide involving children, child abuse must be ruled out before discharging patient to

parent's care. Poison prevention education should be given to parents to prevent recurrence.

The symptomatic patients must be treated aggressively. Initial management should be directed to establish an intravenous line and providing 100% oxygen by a non-re-breathing mask. Gastric lavage protecting airways may be considered. Symptomatic patients should be admitted and observed for 48-72 hours for the development of delayed onset pulmonary edema. During observation period, the patient should be monitored closely for cardiac, hepatic and renal functions as well as fluid and electrolyte status. Non cardiogenic pulmonary edema should be managed aggressively which may involve endotracheal intubation and use of positive end-expiratory pressure (PEEP) ventilation. Excessive fluid administration should be avoided.

Conclusion

Patients poisoned with zinc phosphide have mild and self-limiting symptoms unless massive amount is ingested or in case of a mixed ingestion. Patient who presents to hospital emergency asymptomatic and remains asymptomatic for 4-6 hours of observation is most unlikely to develop late toxicity. Therefore, reduction of unnecessary hospital observation for asymptomatic patients is expected to save public health resource. Supportive and symptomatic care is the mainstay of the therapy, even after symptomatic zinc phosphide poisoning. All intentional self-poisoning cases should be referred to psychiatric/ psychological counseling. The psychiatric/psychological evaluation should include assessment of all associated factors of suicidal attempt such as severity of suicidal attempt, stressful life events, personality factor and associated mental illness. The detail evaluation of those factors will help clinicians to take necessary therapeutic intervention so as to reduce reattempt.

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