

Original Research Article

Clinical profile and outcome of rodenticide poisoning in patients admitted to a tertiary care teaching hospital in Mysore, Karnataka, India

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ABSTRACT

Background: Rodenticide poisoning is of the major types of poisoning prevalent in India. However this broad category consists of different type of compounds with different mechanisms of toxicity and variable mortality rates.

Methods: This study was performed on all cases of rodenticide poisonings admitted to a tertiary care hospital in Mysore between May 2014 and April 2015. Study consisted of 64 subjects.

Results: 31 subjects had consumed aluminium phosphide, 18 had consumed Yellow Phosphorus and 12 had consumed Zinc Phosphide while 3 patients had consumed bromadiolone. There were 13 mortalities among the study group out of which 9 were in aluminium phosphide group while 4 were in the yellow phosphorus group. There were no mortalities in cases who had consumed zinc phosphide and bromadiolone.

Conclusions: Aluminium phosphide was the most common compound rodenticide consumed and it was associated with increased mortality as compared to other Rodenticide poison.

Keywords: Aluminium phosphide, Bromadiolone, Magnesium sulphate, Rodenticide poisoning, Yellow phosphorus

INTRODUCTION

Rodenticides, more commonly referred to as rat poisons, are of following common types-anticoagulants, metal phosphides (aluminium phosphide, zinc phosphide), yellow phosphorus. Other types include Calciferols, Barium carbonate, alpha-Naphthylthiourea (ANTU). Each one of them has different methods of action.

Hence they have different toxicological profiles with variable fatality rates in humans when consumed by accident or intentionally.¹ Anticoagulants commonly used as a rodenticide are Bromadiolone. It is a second-generation 4-hydroxycoumarin derivative and Vitamin K antagonist. It is commonly referred to as "Super Warfarin" due to its potency. It inhibits Vitamin K

epoxide reductase which is required for regeneration of Vitamin K thus preventing the maturation of vitamin K dependant clotting factors. Metal phosphides commonly used are aluminium phosphide (ALP) and zinc phosphide. Aluminium phosphide is used as a fumigant while zinc phosphide is used as bait.

Aluminium Phosphide is used as a solid fumigant used for grain storage. It is also cheap and easily available. They are colloquially referred to as "Rice Tablets". It is available in the tablet form in sizes of around 2cm diameter and 0.5 cm thickness. Sizes vary between different manufacturers. They typically contain about 3-3.5 gm of aluminium phosphide. It is sold in an air tight package. When exposed to water or moisture in the air it releases phosphine gas which is cytotoxic.

The toxicity of aluminium phosphide is attributed to the liberation of phosphine gas, a cytotoxic compound that causes free radical mediated injury, inhibits vital cellular enzymes and is directly corrosive to tissues. The following reaction releases phosphine when ALP reacts with water in the body: $ALP + 3 H_2O \rightarrow AL(OH)_3 + PH_3$, and $ALP + 3 HCl \rightarrow AlCl_3 + PH_3$ (stomach)

Zinc phosphide is used as in bait. Phosphine is produced on exposure to water and it mediates the toxicity. Hydrolysis is strongly pH-dependent for zinc phosphide. At pH 4, 7.1% of zinc phosphide hydrolyzed in 12 hours, whereas 38.8% hydrolysed at pH 2 over the same period. Yellow Phosphorus (white phosphorus) is commonly available as a paste which is spread over bait. "RATOL" is the most popular brand. Phosphorus is a general protoplasmic poison causing cardiac, hepatic, renal, and multi organ failure.

Calciferols (alone or with anticoagulants) are used as rodenticides. It acts by causing hypercalcemia by increasing absorption from the intestines and by mobilising skeletal reserves. It also leads to hyperphosphatemia. It leads to renal failure, cardiac abnormalities, hypertension, CNS depression, anorexia, vomiting, diarrhoea, and lethargy. The effects are due to calcification of the soft tissues. Other agents like Barium carbonate and alpha-Naphthylthiourea (ANTU) are not widely used by general population.

In the study done by Khurana P et al at Amritsar showed a mortality rate of 76% among aluminium phosphide poisoning. Shock and un recordable pulse rate were the major signs suggesting a myocardial damage. Their study also showed that metabolic acidosis with a pH <7 was a poor prognostic sign as all the patients had expired. While all the patient with a normal pH had survived.²

The mortality rates for Aluminium Phosphide poisonings vary from 40-80% according to various studies.³ Mortality rates of Yellow Phosphorus poisoning ranges from 23% to 73%.⁴ Apart from rodenticides it is also found in fire crackers. The mortality rate of zinc phosphide poisoning is around 37-100%.⁵

There is no antidote for phosphide poisoning. As aluminium phosphide poisoning causes cardiac toxicity, Magnesium sulphate has been used to stabilise the cardiac membrane to prevent mortality. However studies have shown mixed results.⁶⁻⁸

METHODS

Present study was a prospective observational study done on patients aged more than 16years who had presented with history or signs of rodenticide poisoning over a period of 1 year between May 1, 2014 and April 30, 2015 to JSS Medical college hospital a tertiary care in Mysore, Karnataka. The data and information pertaining to the cases were collected and recorded on a proforma.

Wherever possible the attendants of the patient were asked to get the package or the package insert of the poison to confirm the history and examination findings. A complete Hemogram, renal function tests, liver function tests, prothrombin time, ECG were done for all the patients. Other investigations like Arterial Blood Gas Analysis, Echocardiogram were left to the discretion of the treating physician and are hence were not performed for all the patients.

The clinical profile was recorded according to the Poisoning Severity Score grading.⁹ In this score every system is graded from 0 to 4 (Where 0 indicated no involvement of the system whereas 4 indicated death occurring due to the involvement of that system).

RESULTS

There were a total of 64 patients who were admitted with rodenticide poisoning during the 1 year study period. Of these, 31 patients had consumed aluminium phosphide, 18 had consumed yellow phosphorus and 12 had consumed zinc phosphide while 3 patients had consumed Bromadiolone (Figure 1).

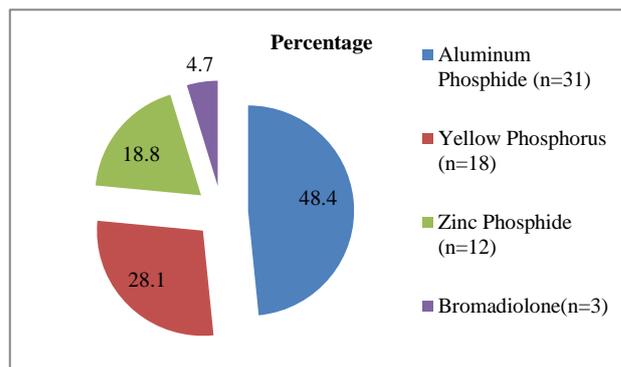


Figure 1: Distribution various types of rodenticide poisoning.

Of the cases, 29(45.3%) were female and 35 (54.7%) were male. A majority of the patients in the study group were in 21-30 age groups (53.1%), while those between 16 and 20 accounted for 25% of the cases. The rest were more than 30 years of age (n=14). The months of June and July had the most number of these poisonings (9 each). During the month of May there were only 2 cases. Majority of the cases were homemakers by occupation (n=21) (32.9%). Students were the next largest group (n=13) (20.3%). The third largest group were farmers (n=10) (15.6%).

The mean time since consumption at presentation was 20.41 hours. The median was 4 hours. The minimum was 1 hour and one patient had presented 7 days after presentation. Among 64 cases 4 had previously attempted self-harm earlier. The poisoning severity score at admission was 3 in 25 cases (39.1), 2 in 20 cases (31.3%), 1 in 15 cases (23.4%). 44 of the 64 cases

(68.8%) had survived the poisoning; while 13 cases (20.3%) had expired. 7 cases were discharged against medical advice. Most of the cases discharged against medical advice had severe toxicity. In this study, out of the 13 mortalities, 9 were in patients who had consumed

aluminium phosphide while 4 were in patients who had consumed yellow phosphorus. There were no mortalities in cases who had consumed Zinc Phosphide and Bromadiolone (Table 1).

Table 1: Outcome of rodenticide poisoning.

	Survived	Expired	DAMA
Aluminium Phosphide (n=31)	18 (58.1%)	9 (29.0%)	4 (12.9%)
Yellow Phosphorus (n=18)	11 (61.1%)	4 (22.2%)	3 (16.7%)
Zinc Phosphide (n=12)	12 (100.0%)	0	0
Bromadiolone (n=3)	3 (100.0%)	0	0
Total (n=64)	44 (68.8%)	13 (20.3%)	7 (10.9%)

Aluminium phosphide

A total of 31 patients out of 64 had consumed Aluminium Phosphide. They had consumed a mean of 7.5 grams of aluminium phosphide each. The mean values of Poison consumption were 5.11 grams among patients who survived and 11.66 grams in those who expired. Only 10

out of the 31 cases (34.5%) had received Magnesium Sulphate immediately at presentation to the hospital. While 17 more of the cases had received it later during the course of hospital stay. The average time since consumption to treatment with magnesium sulphate was 4.83 hours in the expired patients while it was 6.18 hours in the patients who had survived.

Table 2: Rodenticide poison and their effect on LFT and ABG.

	Aluminium phosphide		Yellow phosphorus		Zinc phosphide	Bromadiolone
	Outcome		Outcome		Outcome	Outcome
	Survivors	Expired	Survivors	Expired	Survivors	Survivors
Liver Function Tests						
Total Bilirubin	0.74	0.76	3.50	4.47	0.74	0.67
Total Bilirubin (5 th Day)	1.05	-	2.66	-	0.75	-
AST	33.18	90.29	170.45	1206.75	29.08	26.67
AST (5 th Day)	41.50	-	63.1	-	35.56	-
ALT	23.76	98.29	176	643	23.33	20.67
ALT(5 th Day)	34.33	-	97.9	-	52.89	-
PT-INR	1.1	1.42	1.7	4.9	1.0	1.0
PT-INR (5 th Day)	1.03	-	1.2	-	1.3	0.9
Arterial Blood Gases(ABG)						
pH	7.34	6.95	7.37	7.32	7.35	-
HCO ₃ ⁻	16.09	6.65	21.50	14.47	19.6	-
S. Lactate	3.2	11.3	1.9	4.1	1.7	-

Among the 27 cases who received Magnesium sulphate, 18 were discharged (66.6%), 6 cases expired (22.2%) and 3 cases got discharged against medical advice. While 3 out of the 4 cases (75%) which didn't receive Magnesium sulphate expired.

The most common systems involved were Gastrointestinal Tract (n=27) (87.1%), Metabolic Balance (n=22) (70.9%), Cardiovascular System (n=17) (54.83%).

Other systems that were involved were respiratory system, nervous system, liver dysfunction, renal dysfunction.

Yellow phosphorus

Yellow phosphorus consumption was the second most commonly ingested rodenticide in this study. It was consumed by 18 of the 64 cases (28.1%). Of these cases,

11 (61.1%) cases survived, 4 (22.2%) cases expired while 3 (16.7%) cases were discharged against medical advice. The quantity of poison consumed in those who had survived was 3.52 grams while those who had expired consumed 5.75 grams.

Magnesium Sulphate was given in 13 out of the 18 cases. Of the cases that were given $MgSO_4$, 8 survived while 3 expired and 1 patient got discharged against medical advice. While among those who had not received $MgSO_4$, 3 survived while 1 case expired and another got discharged against medical advice.

3 of the 18 cases (16.7%) had received N-Acetyl cysteine at presentation. While 13 other cases received N-Acetyl cysteine later during the admission. Among the cases that received n-acetyl cysteine, the survivors received at an average of 49.70 hours of consumption while the cases who expired received after an average of 70.33 hours of consumption.

The systems affected were gastrointestinal tract (100%), Liver (66.70%), CVS, Nervous and respiratory systems along with associated metabolic abnormalities (66.7%). Metabolic score couldn't be calculated for every case as ABG wasn't done for all the cases. In patient with a Metabolic Balance score in the PSS grading of 2 at presentation (n=1), the patient expired. In patients with a metabolic balance score in the PSS grading of 1 at presentation (n=3), 2 cases expired while 1 case survived.

Zinc phosphide

Zinc Phosphide was consumed by 12 cases in this study. All of the cases survived and were discharged. On an average, the cases consumed 13.37 grams. On an average these cases presented to the hospital 9.5 hours after consumption.

The average duration of stay in the hospital was 103.83 hours. 3 out of the 12 cases had received $MgSO_4$ immediately after admission into the hospital. 7 other cases received it later during their stay in the hospital while 2 cases did not receive zinc phosphide. 11 of the 12 cases received N-Acetyl Cysteine during the stay in the hospital. The PSS score at admission was 3 in 1 (8.3%) case, 2 in 5 (41.7%) cases and 1 in 4 (33.3%) of the cases.

The common systems that were affected were Gastrointestinal tract (83.3%), Metabolic system (33.3%), CVS (16.7%). Other systems that were involved were respiratory systems, nervous system and liver.

Bromadiolone

This rodenticide was consumed by only 3 (4.7%) of the 64 cases. All three of the cases survived and were discharged. 2 cases had a PSS score of 2 at presentation. While the other patient had a PSS score of 0. In 2 of the

patients, the gastrointestinal tract was involved while one of them also had an involvement of the respiratory system.

DISCUSSION

Present study had a total of 64 rodenticide poisoning cases. Over the same period there were a total of 549 cases of acute poisonings admitted in our centre. It was the third most common category of poison consumed after organophosphorus (n=176) and drug abuse (n=163). The highest mortality was found to be in the cases who had consumed aluminium phosphide.

These cases had a tendency to present with cardiac toxicity with features of shock, arrhythmias. The death in these cases usually occurred within the first 48 hours as the Mean duration of stay in the expired group was 18.33 hours.

The mean time since consumption for death was 22.58 hours. Some of the poor prognostic factors in Aluminium Phosphide poisoning were PSS CVS Score of 3, PSS Metabolic Score of 3, low pH, low bicarbonate levels, high AST and ALT levels (Table 2).

Patients who received Magnesium Sulphate had better chances of survival in our study (Mortality rate 22.2%). 3 patients out of the 4 patients didn't receive Magnesium Sulphate expired. These numbers were not statistically significant to conclude that magnesium sulphate improved the outcome in cases of aluminium phosphide poisoning.

Present study showed a mortality rate of 33% among aluminium phosphide poisoning cases which is lower than the study conducted by Chugh which had a mortality rate of 77.2% and similar to the study by Hemani where the mortality rate was 35%.^{10,11}

The drawback in our studies were Metabolic score couldn't be calculated for every case as ABG analysis wasn't done for all the cases. It was performed in only 7 of the 12 among Zinc Phosphide poisoning, 11 of the 18 cases in Yellow Phosphorus poisoning and 15 of the 31 Aluminium Phosphide poisoning cases. The use of Magnesium was not mandated and the decision up to the discretion of the treating physician. Hence there was not uniformity on the initiation of magnesium sulphate among the cases.

CONCLUSION

Among the rodenticides, Aluminium Phosphide is the foremost common cause for mortality in our study. Even though Magnesium sulphate's usage has shown better prognosis in our study, in view of less number of cases a large randomized controlled trial is necessary to prove Magnesium Sulphate's therapeutic potential in improving the outcome.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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