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Original Research Article

A retrospective study of clinical profile and outcome of patients with rodenticide poisoning in a tertiary care hospital

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ABSTRACT

Background: In developing countries, the substances most commonly used for self-poisoning are agricultural pesticides including rodenticides. Authors aimed to assess the clinical status and outcomes of patients with rodenticide poisoning in a tertiary care hospital.
Methods: This retrospective record-based study was carried over three years. Apart from demographic details, information regarding the time of ingestion, nature and amount of the compound. Other details included clinical features, complications, treatment and outcome of the patient. Descriptive analysis was carried out by the mean and standard deviation for quantitative variables, frequency and proportion for categorical variables.
Results: Of the 120 study subjects, 85 (93.40%) participants self-harmed, 2 (2.20%) were homicidal, and 4 (4.40%) had accidentally consumed the rodenticide. About 52 (32.70%) participants had vomiting, 34 (21.38%) had giddiness, 32 (20.13%) participants had abdominal pain. On the whole, 85 (73.28%) participants recovered, 23 (19.83%) participants had absconded, 6 (5.17%) participants had referred and 2 (1.72%) of them expired.
Conclusions: Phosphorous compounds, particularly yellow phosphorous are the most lethal rodenticides followed by Coumadin. Symptomatic management of the patients at the earliest possible time is the mainstay, as there are no specific antidotes for any of the compounds.

Keywords: Rat killer poisoning, Rodenticide poisoning, Self-poisoning

INTRODUCTION

Poisoning directly or indirectly is responsible for more than one million illnesses worldwide.[1] Deliberate self-poisoning has become an increasingly common response to emotional distress in young adults, and it is now one of the most frequent reasons for emergency hospital admission.[2] Suicide is an important cause of premature death and the WHO estimates to be nearly 800,000 in number.[3] In industrialized countries, the drugs people commonly take in overdose-analgesics, tranquillizers, antidepressants are relatively non-toxic.[4] The estimated case fatality for overdose in England, for example, is around 0.5%.[5] In developing countries, the situation is quite different.[6] The substances most commonly used for self-poisoning are agricultural pesticides including rodenticides.[1,3,7] Overall case fatality ranges from 10%-20%.[8] For this reason, deaths from pesticides poisoning make a major contribution to patterns of suicide in developing nations, particularly in rural areas.[9] Three million cases of pesticide poisoning occur worldwide annually, with 2,20000 deaths, the majority of which are intentional.[10] Rodenticides are a heterogeneous group of compounds, commercially available which are used for

agricultural and domiciliary purposes account for one of the most frequent types of poisoning in India. They are available as powder, cake or paste forms in the market at very low cost, hence easily acquired. Rodent poisons are added to baits (palatable grains or paste) intended to encourage rat consumption. There are various classes of compounds which are available as rodenticides: namely, anticoagulants like warfarin other coumarins and indandiones and their more toxic second-generation type are super warfarin's, of which bromadiolone, brodifacoum to name a few. The other kind is inorganic rodenticides like yellow phosphorous, a corrosive substance that damages the tissues it comes in contact with. Zinc phosphide is less corrosive but causes toxic hepatic failure. Thallium sulphate usually affects CVS as it competes with intracellular potassium. The data on the exact number of rodenticide poisonings in India is not available. However, according to American statistics, in the year 2009, 13,922 cases of exposure to rodenticides were recorded in the national poison data system (NPDS).[11] In a retrospective study in southern India in 2002, OP compound was the most common, 30% and RKP was 7.3% with another prospective study done in West Bengal in 2008-2010 showed RKP to be the cause in 16.49% of 4,432 patients.[12] Hospital-based study of acute poisonings in India in 2011-2012 revealed that 170 out of 492 cases were due to rat killer poisoning (RKP), in which, dicoumarol followed by bromadiolone was the commonest type of RKP.[13] The most common symptoms reported were nausea, vomiting, abdominal pain, followed by tachypnea. Common complications include hemorrhagic manifestations, deranged liver function tests (LFT) and prothrombin time (PT) 14 though, the outcomes vary according to the type of compound, the quantity of ingestion and the time of obtaining emergency treatment among others.

Yellow phosphorous compound had mortality between 10-50% in the studies by Shashidhara et al, and Chugh et al, McCarron et al, however, reported mortality was due to zinc Phosphide, and barium carbonate compounds causing ventricular arrhythmias.[11,14,15] Khurana et al, studies at Amritsar reported a mortality of 76% with aluminum phosphide, mainly with myocarditis and in other studies, the numbers were 23-73%.[12,16,17]

However, some studies reporting anticoagulant compounds, bromadiolone poisoning had more deranged PT in 14.3% with no mortality.[18,19] The mortality was between 37-100% for zinc phosphide in one study.[14] The poor prognostic factors of aluminum phosphide poisoning were metabolic acidosis, elevated AST/ALT levels and poor PSS cardiac score. The role of N acetyl cysteine (NAC) in acute liver injury is known. Some studies point its beneficial effects in acute liver injury secondary to yellow phosphorous compound, probably due to anti-oxidant and hepatoprotective nature.[20] A study conducted in Vinayaka Mission Hospital Salem, in 2010-2011, concluded the use of NAC as an adjuvant in the treatment of yellow phosphorous poisoning.[21]

Hence, author intended to study the symptoms, complications and outcome of rat killer poisoning depends on the type and quantity of the compound as well as time between ingestion and treatment.

METHODS

This was a retrospective case record-based study carried out at a tertiary care centre for three years between 2014 and 2016.

Included criteria

Case files of all patients aged 13 years and above admitted to this institute with rodenticide poisoning, were included.

Excluded criteria

Incomplete case records or case records of patients who have absconded on the first day itself were excluded.

After obtaining permission from the institutional ethical committee, the case records of patients with rodenticide poisoning were retrieved from the medical records department.

The data included demographic like age, gender, marital status, along with information regarding the time of ingestion, nature and amount of the compound. Other details included clinical features, complications, treatment and outcome of the patient. If the patient is referred, the indication for referral will be noted. The severity of acute liver failure will be assessed by model for end-stage liver disease (MELD) score.[22] MELD =11.2 loge (INR)+3.78 loge (bilirubin (mg/dL))+9.57 loge (creatinine (mg/dL))+6.43. (range 6-40). Indian rupee (INR). The sequential organ failure assessment score (SOFA) score will be used to assess the overall severity and organ dysfunction if any.[23]

Descriptive analysis

Descriptive analysis was carried out by the mean and standard deviation for quantitative variables, frequency and proportion for categorical variables.

RESULTS

A total of 120 patients who had consumed rodenticide poison with a mean age of 28.45±10.63 years, the youngest was 13 years, while the eldest was 75 years.

Among the study population, 79 (65.80%) participants were aged below 30 years, 26 (21.70%) participants were aged between 31 to 40 years, 11 (9.20%) participants were aged between 41 to 50 years, 3 (2.50%) participants were aged between 51 to 60 years and 1 (0.80%) participant were aged between more than 60.

Table 1: Demographic distribution of the subjects.

Demographic parameter	Frequency	Percentages
Age group		
Up to 30	79	65.80
31 to 40	26	21.70
41 to 50	11	9.20
51 to 60	3	2.50
60 and above	1	0.80
Gender		
Male	67	55.80
Female	53	44.20

Table 2: Clinical profile of the study population.

Parameter	Frequency	Percentage
Mode of poisoning		
Suicide	114	95.0
Accidental	5	4.17
Homicide	1	0.83
Time of presentation		
<1 hour	40	33.33
1-3 hours	44	36.67
3-6 hours	24	20
6-12 hours	10	8.33
>12 hours	02	1.67
Symptoms at present to the hospital		
Nausea and vomiting	44	36.67
Giddiness	24	20.00
Abdominal pain	20	16.67
Asymptomatic	20	16.67
Palpitation and chest pain	10	8.33
Palpitations	1	0.83
Seizure	1	0.83
Type of chemical compound consumed		
Coumarin	45	37.50
Zinc phosphide	40	33.33
Yellow phosphorus	26	21.67
Unknown compound	9	7.50%

Among the study population, 114 were suicidal, five of them were accidental, and one patient was homicidal. Regarding the time taken to report to the hospital, 40 (33.33%) participants presented within 1 hour, 44 (36.67%) of them between 1 to 3 hours, 24 (20%) of them between 3 to 6 hours, 10 (8.33%) of them between 6 to 12 hours and 2 (1.67%) reported after 12 hours.

The symptoms presented by the patients were predominantly nausea and vomiting (36.67%) followed by giddiness (20%), abdominal pain (16.67%), while 16.67% of them were asymptomatic. Among the study population, coumarin (37.5%) was the most common compound ingested, 33.33% had consumed zinc phosphide, and 21.66% had ingested yellow phosphorus (Table 2).

History of psychiatric illness revealed, ISH (Intentional self-harm) (22.5%) as the major type followed by ADS (alcohol dependent syndrome) along with ISH (16.66%), 8.33% had depression. (Table 3).

All the patients were given an appropriate treatment of which, 72.5% recovered completely, 16.7% of them absconded, 6.7% of them were referred for further management, 2,5% of them were discharged against medical advice (AMA), and two patients (1.7%) expired (Table 3).

Out of 45 patients who consumed with bromadiolone (coumadin), 31 had recovered, nine absconded and four were referred to higher centre, and one subject left AMA. Out of 40 patients with zinc phosphide poisoning, most of them (38) recovered, one went AMA, and one absconded.

Out of 26 patients with yellow phosphorous poisoning, 16 of them improved, two died due to complications of fulminant liver failure, one left AMA, three absconded and four patients were referred to a higher centre (Table 4).

Table 3: History of psychiatric illness.

Psychiatric illness	Frequency	Percent
ISH	27	22.5
ADS+ISH	20	16.66
Depression	10	8.33
Adjustment disorder	5	4.17
EUPT	4	3.33
Impulsive ACT	3	2.5
Psychosis	1	0.83
Nil	55	45.83

Table 4: Comparison of outcome with each compound.

Compound	Outcome				
	Recovered	**Death**	**AMA**	**Absconded**	**Referred**
Bromadiolone (N=45)	31 (68.8%)	0 (0%)	1 (2.2%)	9 (20.0%)	4 (8.8%)
Zinc Phosphide (N= 40)	38 (95%)	0 (0%)	1 (2.5%)	1 (2.5%)	0 (0%)
Yellow Phosphorous(N=26)	16 (61.5%)	2 (7.6%)	1 (3.8%)	3 (11.5%)	4 (15.3%)
Unknown (N= 9)	2 (22.2%)	0 (0%)	0 (0%)	7 (77.7%)	0 (0%)

*No statistical test was applied- due to 0 subjects in the cells.

Among the 45 patients with bromadiolone compound poisoning, 14 had nausea and vomiting, 13 were asymptomatic, 11 had giddiness, 6 had abdominal pain. Among subjects with zinc phosphide consumption, 20 had nausea and vomiting, 10 had palpitation and chest pain, 8 had abdominal pain, 6 participants had giddiness, and five were asymptomatic. Among those with zinc phosphide intake, 10 had nausea and vomiting, 7 had giddiness, 6 had abdominal pain, two were asymptomatic (Table 5).

Table 5: Comparison of symptoms at presentation with the type of compound.

Symptoms at presentation	Compound		
	Bromadiolone (N=45)	Zinc phosphide (N=49)	Yellow phosphorus (N=26)
Asymptomatic	13 (28.89%)	5 (10.20%)	2 (7.69%)
Abdominal pain	6 (13.33%)	8(16.33%)	6 (23.08%)
Nausea and vomiting	14 (31.11%)	20 (40.82%)	10 (38.46%)
Giddiness	11 (24.44%)	6 (12.24%)	7 (26.92)
Palpitation	01 (2.22%)	0 (0%)	0 (0%)
Palpitation and chest pain	0 (0%)	10 (20.41%)	0 (0%)
Seizure	0 (0%)	0 (0%)	1 (3.85%)

Among the patients with complications, 7 had bleeding manifestations (5 due to yellow phosphorous,2-coumadin). Encephalopathy was seen in 5 patients with yellow phosphorous poisoning. Hypotension complicated two patients with yellow phosphorous poisoning, 1 had myocarditis and cardiogenic shock. About 10 of 26 (38.46%) patients with yellow phosphorous intake developed fulminant hepatic failure, and they were given N-acetyl cysteine. However, only four patients improved while four patients were referred for liver transplantation and two expired. Three patients had delayed presentation with an average quantity of yellow phosphorous paste of 80 grams.

DISCUSSION

Poisoning is a major health problem worldwide. It can be suicidal, accidental or occupational. However, it is deliberate self-poisoning that causes the great majority of deaths and the immense strain that pesticides put on hospital services, particularly in developing countries like India. Pesticides like rodenticides are a heterogeneous group of compounds usually intended for killing rats and mice. These compounds, however, show sharply distinctive toxicities among humans and rodents.

In our study, rat killer poison was a common mode of self-harm as we recorded a total of 120 cases in a year as compared to 64 cases in 1 year (Mysore) 24 and 97 in 2 y ears in Manipal, Karnataka, India.[21] Among the study population, 65.80% of participants were aged below 30 years, 21.70% of them were between 31 to 40 years, 11.70% were aged between 41 to 60 years. Concurring the findings was a two-year retrospective study in south India that noted most its patients (82.5%) belonging to 18 to 40 years age group while 13.4% were aged 41 to 60 years.[21] However, a study done at Mysore found 57.1% of patients aged between 20-40 years. [24] Of the 120 cases, 37.5% had consumed coumadin (bromadiolone), while 33.3% had zinc phosphide and 21.7% yellow phosphorous. Contrastingly, Nalabothu et al, reported maximum cases (44.3%) consuming yellow phosphorous, followed by 28.9% zinc phosphate and 21.6% superwarfarins.[21] Suneetha et al, noted zinc phosphide (32.14%) as the most common compound, followed by aluminium phosphide (21.4%) and yellow phosphorus (14.2%).[24] Regarding the mode of poison consumption, 93.40% of participants had self-poisoned, 2.20% through homicidal mode and 4.40% had consumed accidentally. Similar to the present study, subjects (94.8%) in the study by Nalabotu et al, mostly consumed the poison intentionally, with rest (5.2%) having it accidentally.[21]

Among the study population, 32.70% participants had GI symptoms like nausea and vomiting, 21.38% of them had giddiness, 20.13% had abdominal pain,7.54% had nausea, 3.14% participants had a headache, and 2.51% had palpitations. Contrastingly the Manipal study found 85.7% patients having nausea and vomiting and 56.7% had abdominal pain, 16.4% had bleeding manifestations, 29.8% of them had altered sensorium seen. The study found that patients that consumed phosphorous compounds had high mortality, an early manifestation of hepatic failure which lines the study findings. There are many reasons, why people resort to self-harm in countries like India. Poverty, inadequate income to run the family, monsoon failure and the resultant high debts could be the drivers for labourers and farmers.[25] Among unemployed and homemakers, factors, such as dowry, cruelty by the in-laws, family quarrels, maladjustment in married life, and dependence of women on the husband, are responsible for the higher incidence of poisoning. Inability to meet the high expectations from parents and teachers and consequent failure in the exams has increased the incidence of poisoning among students.

Outcome of bromadiolone

Out of 45 of patients that consumed bromadiolone, 73.3% recovered, 20% of them absconded and one DAMA. In comparison, a Taiwanian study by Yu HY et al, reported 20 patients with super warfarins poisoning over a period of 11 years, of whom all of them survived.[26] Nearly 80% of them self-harmed themselves, with 60% of them consuming bromadiolone. Bromadiolone is a derivative of 4-hydroxycoumarin, commonly referred to as super warfarins. Super warfarins have the same mechanism as warfarin but are 100 times more potent and have much longer serum and tissue half-lives.[27] They mainly act by blocking the regeneration of active vitamin K by epoxide reductase enzymes with ensuing bleeding diathesis or complication.[28] The increased efficacy of super warfarins as rodenticides is due to their high lipid solubility, affinity for hepatic tissue and slow elimination from the body.

The outcome of zinc phosphide: all patients survived with no complications, while one patient was DAMA and one patient absconded. Poorer prognosis among the subjects of Nalabotu M et al, with only 57.1% survivors, 35.7% non-survivors and two patients were DAMA.[21] Chugh SN et al, reporting 20 cases of zinc phosphide self-poisoning over a period of five years, reported a mortality of 25%.[18]

Yellow phosphorous: Of the 26 patients, 61.5% recovered, 7% expired, 11% absconded and one patient was DAMA. Contrastingly, more harm was seen in patients of Nalabotu M et al, where only 48.8% survived, 27.9% expired and 23.2% DAMA.[21] Reviewing 15 cases of yellow phosphorous poisoning, Fernandez et al, observed very high mortality (27%) and concluded that yellow phosphorous is extremely lethal when consumed, owing to hepatotoxicity (33%).[29] In line with these findings, 5 out of 7 patients who had bleeding manifestations had consumed yellow phosphorous. Encephalopathy was seen in 5 patients with yellow phosphorous poisoning. Hypotension complicated two patients with yellow phosphorous poisoning, one had myocarditis and cardiogenic shock. About 10 of 26 (38.46%) patients with yellow phosphorous intake developed fulminant hepatic failure, and they were given N-acetyl cysteine. However, only four patients improved while four patients were referred for liver transplantation and two expired.

The high toxicity of modern pesticides like rodenticides and non-availability of any specific antidotes, delay in seeking medical care is responsible for higher mortality among those who consume them.[30] This is further compounded by a lack of awareness and the presence of psychiatric illnesses among the vulnerable.

There is a general consensus that the ease of availability of especially lethal modes of self-harm may affect patterns of suicide. Suicidal impulses are frequently short-lived and if time can be 'bought' allowing such impulses to pass -by making the means of suicide less readily available a proportion of suicides will be prevented.

CONCLUSION

The study findings revealed that phosphorous compounds especially yellow phosphorous are the deadliest rodenticides followed by Coumadin. Consumption of yellow phosphorous was mainly associated with the early manifestation of fulminant hepatic failure. Patients with zinc phosphide had palpitations and chest pain. Symptomatic management of rodenticide poisoning at the earliest possible time is the mainstay, as there are no specific antidotes for any of the compounds.

The public should be educated about the dangers of pesticide poisoning and the safekeeping of pesticides-through media campaigns and clear labelling of product containers. The need for family support and if needed professional counselling for the high-risk groups cannot be over emphasized.

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