

Rat Killer Poisoning vs. Liver Damage: A View in South Indian Patients of Tertiary Care Center

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Abstract

Background: Rodenticide ingestion is common suicidal poisoning. In the absence of antidote, consumption is fatal. We aimed at socio-demographic characteristics, analyzed predictive factors, biological elevation curve and its outcome.

Methods: 101 patients admitted with rodenticide poisoning. Socio-demographic characteristics, probable predictive factors, Serial charting biological markers recorded. Standard care management was given.

Results: Of the 101 patients 76% were from rural and 24% urban. 62% were female and male 38%. Mean age was 26.0 ± 10.467 years. Unmarried men and married women were higher. Higher number was literate 46% and Illiterate 28%. Higher number was salaried 45% and students 30%. 34% consumed raw, 30% mixed with water. 57% ingested <10 grams, 24% up to 20 and 20%, >20 grams. Mean dosage of 13.42 ± 7.069 grams. Mean care seeking time 6.0 ± 6.3702 hours. 46% sought <3 hours, 41% in 10 and 13% >10 hours. Chief symptom was vomiting in 33% patients, abdominal pain 36%, headache 27% and oral bleeding 4%. Biological markers in survivor and non-survivor showed, T bill, Albumin, AST, ALT, Creatinine, PT, INR and MELD were statistically significant. T protein, platelet and urea were not significant. 9 patients had MELD <10, 30-(11-20), 35-(21-30) and >30 MELD was in 27. All of those had a MELD of >40 died. 41% had toxic hepatitis, 21% acute liver failure, 19% toxic hepatitis with acute kidney injury/ALF with acute kidney injury and 19% developed multiple organ failure. Overall mortality rate was 19%, 81% recovered with 8.88 days mean hospital stay.

Conclusions: Patient ingested yellow phosphorus had liver damage. Lethal dosage and late presentation to medical facility led to liver failure, multiple organ failure and mortality in spite of standard care. Creating awareness, promoting mental health, suicide prevention and framing proper guidelines of treatment are best cornerstones to reduce mortality by rat killer poisoning.

Keywords: Rodenticide; Lethal dosage; Toxic hepatitis; Acute liver failure; Acute kidney injury; Multiple organ failure; International normalized ratio

Introduction

Rodenticides for many years have been an important cause of significant morbidity and mortality in patients who present to an emergency room with deliberate self-harm. An annual incidence of 500,000 cases has been reported [1]. Reports showed that the rate of poisoning in developing countries ranges from 0.07 to 0.7% [2]. As per National Crime Records Bureau (NCRB) statistics, about 1,31,666 people lost their lives by committing suicide during the year 2014 in India. Poisoning was observed to be the second most common method of suicide (National Crime Records Bureau [3]. In India, suicidal or accidental poisoning with rodenticides containing metal yellow phosphorous (Ratol' which has ZnP in paste form) is a more frequent cause of drug-induced ALF than paracetamol [4]. Renal failure and cardiac failure due to toxic cardiomyopathy were the commonest secondarily affected systems leading to rapid mortality [5]. A recent study conducted in South India showed that yellow phosphorus was the most common rodenticide used in suicide attempts in the region and carried a 30% mortality despite maximal supportive therapy [6]. The severe clinical symptoms in patients with phosphine poisoning include circulatory collapse, hypotension, pulmonary edema, congestive heart failure, cardiac arrhythmia, and acute renal failure [7]. Both hyperglycemia and hypoglycemia have been reported as clinical features of phosphide poisoning [8]. No specific antidote has been identified; therefore, the main treatment is supportive care. Although some efforts have been made to establish more effective interventions and medications for management, the mortality rate remains high [9-11]. This fatal poison is freely available over the counter in toxic doses at very cheaper prices [12].

Materials and Methods

Study population

101 admitted patients who ingested rat killer poison with suicidal intention. Inform consent forms were received from all patients.

Sample collection and analysis

Patients were screened by clinicians for clinical findings. Patient's age, socio-demographic, anthropometric, and biological markers were tested. Psychiatric analysis revealed Para suicide rather than true intention to die and none had underlying psychosis.

Lists of test conducted

Blood screening for Total protein [13], (Total bilirubin, Urea, Creatinine) [14], (Alanine aminotransferase (ALT), Alkaline phosphate (ALP) [15], Aspartate aminotransferase (AST) [16], Platelet count [17] Albumine [18], PT [19], INR [20] and MELD [21] were done and serial charting of biological markers were recorded. Standard care management was given.

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Quality control

To ensure quality control, normal and abnormal assays were performed along with the test and recorded.

Statistical analysis

Continuous variables are expressed as means and standard deviations and categorical variables as numbers with percentages in brackets. Sub-group analysis of biological markers were done between survivor and non-survivor which was expressed as P-value (<0.005).

Results

Table 1 shows the socio-demographic characteristics of patients ingested rat killer poison. Of the 101 patients 77 (76%) were from rural areas and 24 (24%) were urban. Two thirds were female and the rest males with 62% and 38%. Age group ranged from 15-65 with mean value of 26.0 ± 10.467 years. Most of the patients (45%) ranged between 20-30 years of their age. Thinking that marital status may be a factor, we compared the marital status with the gender of the patients who ingested poison and found that unmarried men were higher among the men who ingested poison and among the women married women were higher than unmarried women. Whether women or men, literacy level of the them also studied which revealed that higher number of patients who ingested poison were literate with schooling 47 (46%). Illiterate with no formal education were 28 (28%). Details on patient's occupation were collected and higher number of patients who ingested were Professionals or salaried 46 (45%) followed by students 30 (30%).

Table 2 shows the mode of ingestion of rat killer poison, lethal dosage and its related profile. Of 101 patients, 34 (34%) of them had it raw, 30 (30%) ingested rat killer poison mixed with water. For any poison, lethal dosage is important to cause illness or death in human.

Characteristics	All households	
	n=101	Percentage (%)
Place of residence		
Rural	77	76
Urban	24	24
Gender		
Male	38	38
Female	63	62
Age group (in years)		
<20	31	31
20-30	46	45
30-40	15	15
>40	9	9
Mean ± SD	26.0 ± 10.467	
Marital status		
Unmarried men	27	27
Married men	11	11
Unmarried women	28	28
Married women	35	35
Literacy status of the patients		
Illiterate with no formal education	28	28
Literate with schooling	47	46
Literate with graduation	26	26
Occupation		
Housewives	16	16
Coolies	9	9
Professionals or salaried	46	45
Students	30	30

Table 1: Socio-demographic characteristics of patients ingested rat killer poison.

Related profile of ingestion of rat killer poison	All Households	
	n=101	Percentage (%)
Mode of ingestion of rat killer poison		
Raw	34	34
Mixed with water	30	30
Mixed with alcohol	20	20
Mixed with food	17	17
Lethal dosage (in grams)		
<10	57	56
11-20	24	24
>20	20	20
Mean ± SD	13.42 ± 7.069	
Care seeking time (in hours)		
<3	46	46
03-10	42	41
after 10	13	13
Mean time taken for care seeking (Mean ± SD)	6.0 ± 6.3702	
Time of manifestation of first chief symptoms (in hours)		
<6	71	70
06-12	25	25
>12	5	5
Mean ± SD	5.7 ± 6.3093	
Most common chief symptoms*		
Vomiting	79	33
Abdominal pain	87	36
Head ache	65	27
Oral Bleeding	10	4

Table 2: Mode of ingestion of rat killer poison, lethal dosage and its related profile; [Multiple responses].

In our study we found that 57 (57%) of the patients took only <10 grams and 24 (24%) of them took up to 20 grams and 20 (20%) of them took more than 20 grams. We found that mean dosage of 13.42 ± 7.069 grams can cause any illness or death to human. Followed by the ingestion, the care givers or parents or friends, carried the patient to health facility was calculated. The mean time taken for care seeking was 6.0 ± 6.3702 hours. The patients sought care in health facility from the onset of symptom were 88 (87%), of them 46 (46%) sought care with 3 hours and 42 (41%) within 10 hours. There were 13 (13%) of them who visited health facility only after 10 hours of poison ingestion.

After the patients arrived to health facility with the symptoms, details of time of manifestation of first chief symptoms was recorded. Time of manifestation of chief symptoms started in 71 (71%) patients within 6 hours, in 25 (25%) between 6-12 hours and in 5 (5%) of patients, manifestation of symptoms started only after 12 hours of ingestion of rat killer poisoning with the mean and standard deviation of 5.7 ± 6.3093 hours. Once the manifestation of symptoms started in patients, the symptoms were also recorded which revealed that most common presenting symptom was vomiting in 79 (33%) patients followed by abdominal pain in 87 (36%) and headache 65 (27%) Oral

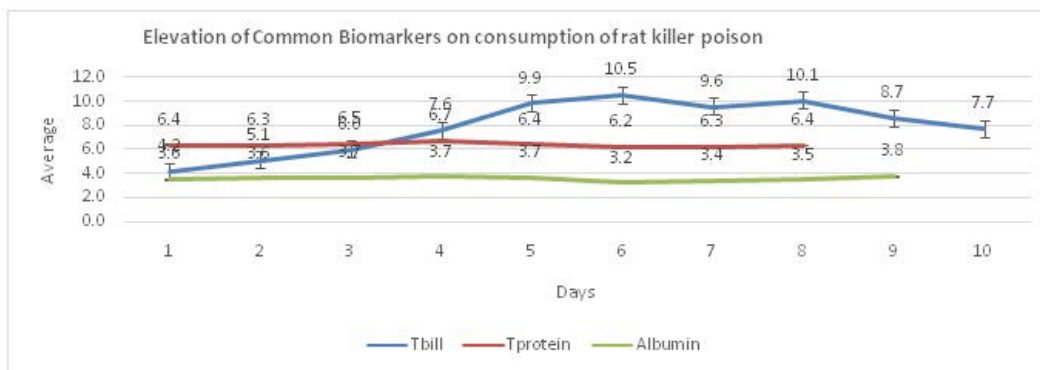


Figure 1: Elevation of common biomarkers on consumption of rat killer poison.

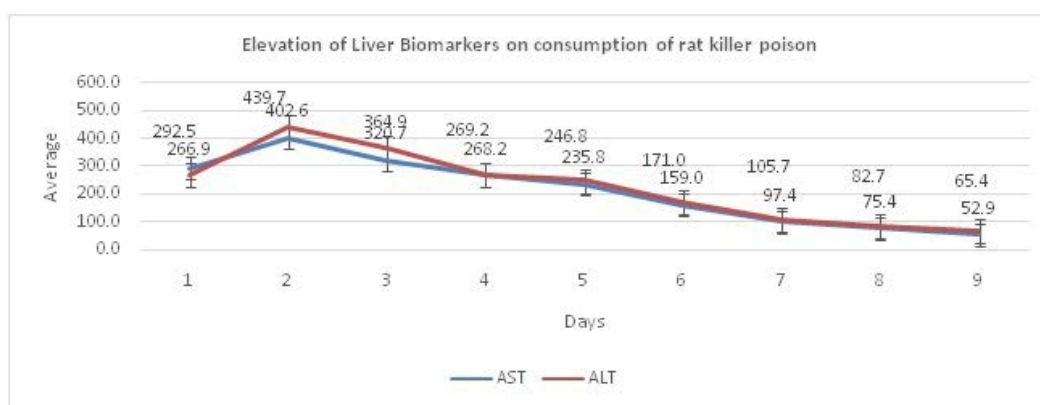


Figure 2: Elevation of liver biomarkers on consumption of rat killer poison.

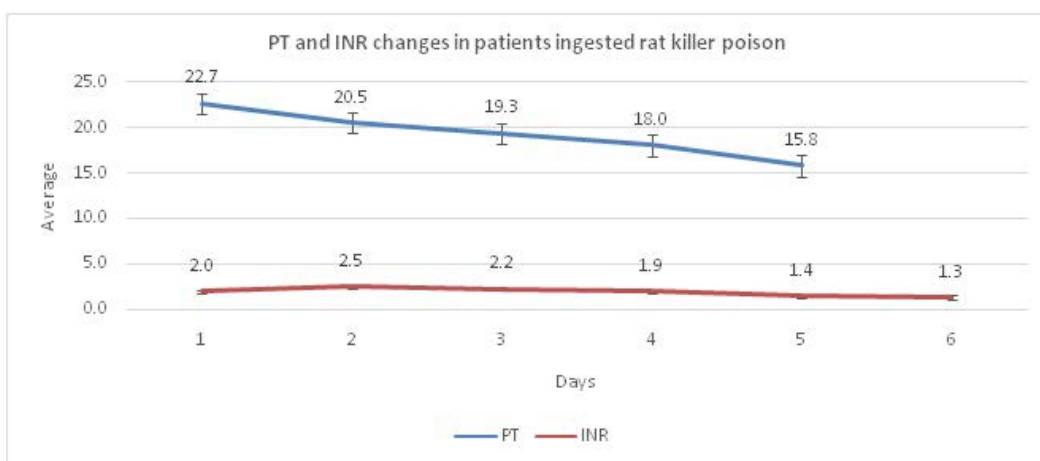


Figure 3: PT and INR changes in patients ingested rat killer poison.

bleeding was also reported in 10 (4%) patients. Multiple responses were given by patients.

As soon as the symptoms started in patients there was a need for evaluation of biological markers. Samples were collected for all the biological markers and the results showed that T. bilirubin were elevated from the 4th day to 8th day of ingestion of rat killer poison and there was high peak level on 6th day with the value of 10.5 mg/dl. Both T. protein and albumin did not show many changes during the hospital stay (Figure 1). Among the biological markers, enzymes like Aspartate

amino transferase (AST) and Alanine aminotransferase (ALT) showed higher level of elevation on 2nd day of admission. Among the liver enzymes, ALT showed 439.7 Iu/ml and AST was 402.6 Iu/ml (Figure 2).

Along with biological marker, Prothrombine Time (PT) was also diagnosed and PT showed reduction and INR did not show any change. The International normalized ratio (INR) was <2 in 69 patients, 2-3 in 11 patients and >3 INR in 21 patients (Figure 3). We performed the sub-group analysis of biological markers recorded in patients who survived and non-survivor in spite of treatment. T. bill, Albumin,

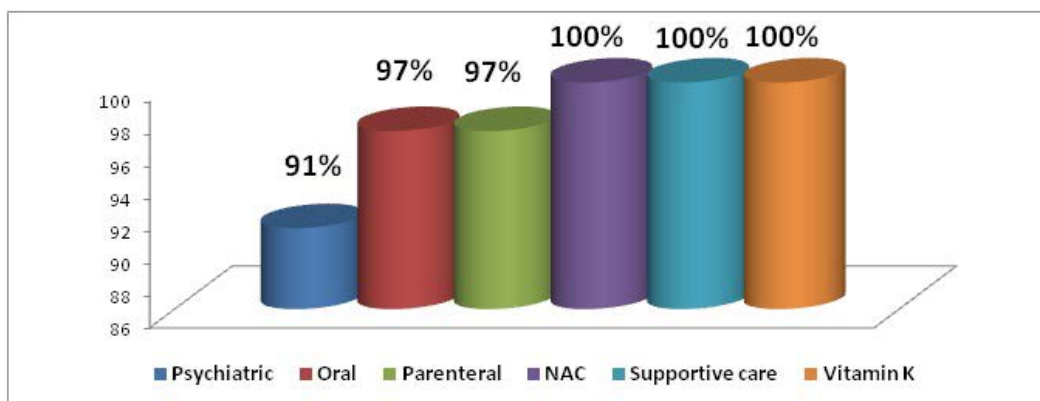


Figure 4: Treatments options given after ingestion of rat killer poison.

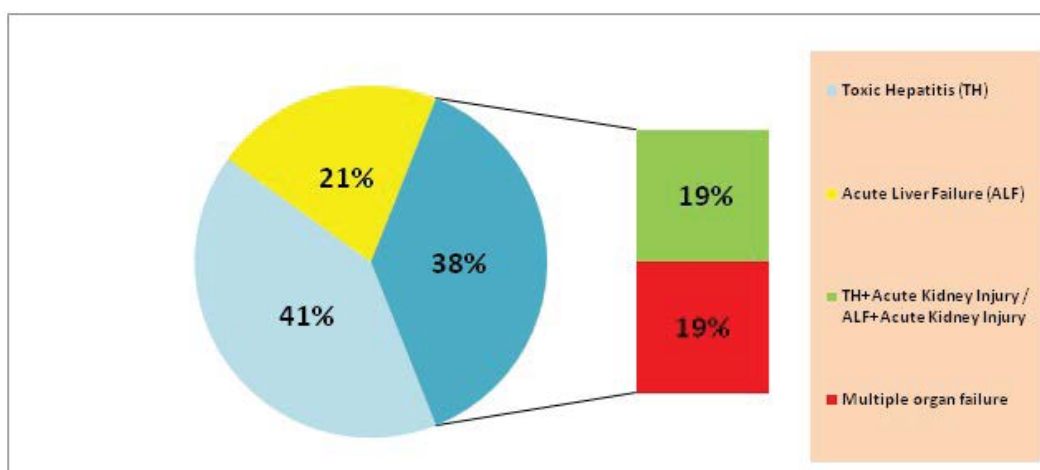


Figure 5: Complications developed after ingestion of rat killer poison.

Elevation of bio Markers	All Households (n=101)		P-value
	Outcome of treatment		
	Non-Survivors (n=19) 19%	Survivors (n=82) 81%	
Bio markers	Mean ± SD	Mean ± SD	
T. bill	8.105 ± 5.3559	3.294 ± 3.8375	0.000'
T. protein	6.232 ± 0.4750	6.442 ± 0.5924	0.153
Platelet	1844.1 ± 8029.06	5742.7 ± 19224.8	0.623
Albumin	3.299 ± 0.4225	3.639 ± 0.4662	0.005'
AST	700.11 ± 518.728	198.05 ± 278.388	0.000'
ALT	648.53 ± 418.914	178.41 ± 230.159	0.000'
Urea	34.53 ± 13.773	26.90 ± 9.316	0.011'
Creatinine	1.268 ± 0.8628	0.849 ± 0.2564	0.004'
PT	31.606 ± 15.3415	20.503 ± 9.8842	0.006'
INR	3.3816 ± 1.64122	1.6732 ± 0.75412	0.000'
MELD	35.47 ± 8.455	21.43 ± 8.346	0.000'

Table 3: Elevation of biological markers between recoded results of patients of non-survivor and survivor after ingestion of rat killer poison; [p value <0.01 as statistical significant].

AST, ALT, Creatinine, PT, INR and MELD were statistical significant (P value=0.005). T. protein, platelet and urea did not show statistical significance. Among the 101 patients, 9 had a MELD of <10, 30 were in 11-20 range, 35 in 21-30 and >30 MELD was found in 27 patients. All of those having a MELD of >40 died (Table 3).

On the basis of biological markers the patients were treated with different method of treatment directed at removal of the poison and supportive therapy. 101 (100%) of patients received treatment like NAC, Supportive therapy and Vitamin-K. 97 (97%) received oral and parental treatment and 91 (91%) patients received Psychiatric treatment (Figure 4). In spite of effective treatment, 41% of patients developed Toxic Hepatitis (TH), 21% showed Acute Liver Failure (ALF) as soon as they ingested rat killer poison. Among the remaining 38% of patients, 19% developed Toxic Hepatitis along with Acute Kidney Injury/ALF along with Acute Kidney Injury. 19% of the patients who ingested rat killer poison developed multiple organ failure which was the reason for their death. The death rate in our study was 19% who developed multiple organ failure. The other 82 patients recovered with mean hospital duration of 8.88 days (Figure 5).

Discussion

Among the 101 patents in our study, Professionals or Salaried were higher followed by students. In a study by Suneetha et al. homemakers

were higher followed by students [22]. Various studies on poisoning done in India Banerjee et al. [23] in west Bengal also noticed most commonly effected age group was 20-40 years. Our study was compatible with Banerjee et al. in the age group. In a study in Thailand by Satariya et al. [24] found that higher number of patient ingested rat killer poisoning mixing with alcohol but our study showed that, many patients ingested either raw or mixed with water.

New finding in our study was the mean lethal dosage (13.42 ± 7.069 gms) of rat killer poisoning which will cause damage to the organs once ingested. Other new finding of our study was manifestation of first chief symptoms which was 5.7 ± 6.3093 hours. "People must seek care in the health facility as soon as they have identified the ingestion of rat killer poison". Saoji AA et al. [10] found in her study that the patients were usually asymptomatic during the initial 72 hour of ingestion, or they may have signs and symptoms of gastrointestinal irritation. Our patients in our study developed symptoms from 5 to 6 hours and vomiting was found in higher number in our patients.

Blotting the biological marker AST and ALT showed higher elevation in patients ingested rat killer poison which indicates that the first affecting organ was liver followed by kidney and other organs. AST was 402.6 on the 2nd day and on 6th day AST reduced to 159.0. Alt was 439.7 on the 2nd day and reduced on 6th day to 171.0. Bhat et al. [1] study showed, the mean admission ALT/AST was 306/451, discharge ALT/AST was 291/302, and peak ALT/AST was 451/655. Few other new findings in our study were elevation graphs were shown for T.bill, T.protein, Albumine, AST, ALT, urea, creatinine, PT and INR for all the patients who ingested rat killer poisoning. Our study again found the statistical significant elevation biological elevation between the survivor and non-survivor.

We found out of 100% patients received treatments like NAC, Vit-K, supportive, 82% of our patients survived and discharged. Mishra AK et al. [25] reveals best results seen among patients in whom NAC was started early in the course of illness. Guidelines do not exist regarding routine use of NAC in non-acetaminophen induced ALF, and in hepatic failure due to rodenticide consumption. Patients admitted with ALF after phosphorus ingestion has sometimes been managed with NAC [26]. We strongly recommend that it is a need of hour to frame proper guidelines of treatment that ingest rat killer poison. However in spite of manageable treatment, half of our patient developed Toxic Hepatitis, 1/3 developed Acute Liver Failure and ¼ developed Toxic Hepatitis along with Acute Kidney Injury / Acute Liver Failure along with Acute Kidney Injury. ¼ developed multiple organ failure which leads them to death. Murali et al. [6] showed 35.7% mortality rate whereas our study showed 19% mortality rate. Survived patients received psychiatric evaluation and were discharged in a stable condition.

Conclusion

Almost all patients with rodenticide poisoning containing yellow phosphorus had liver injury. Lethal dosage and late presentation to medical facility led to development of acute liver failure and mortality in spite of standard of care treatment. Multisystem involvement is almost always fatal. Creating awareness, promoting mental health and suicide prevention is the best option to reduce mortality from such poisonings.

Already Known:

- Age, marital status, gender or education level did not play a role in suicidal intention in patients ingested rat killer poison.

- Lethal dosage like in grams were already known factor.
- Signs and symptoms of gastrointestinal irritation.
- Patients received treatments like NAC, Vitamin-K, supportive.

New Findings:

- Mean dosage of 13.42 ± 7.069 grams can cause any illness or death to human.
- The mean time taken for care seeking was 6.0 ± 6.3702 hours.
- Manifestation of first chief symptoms which was 5.7 ± 6.3093 hours. "People must seek care in the health facility as soon as they have identified the ingestion of rat killer poison".
- Elevations of Biomarkers during the hospital stay were blotted.
- However in spite of manageable treatment, half of our patient developed Toxic Hepatitis, 1/3 developed Acute Liver Failure and ¼ developed Toxic Hepatitis along with Acute Kidney Injury/Acute Liver Failure along with Acute Kidney Injury. ¼ developed multiple organ failure which leads them to death.

Ethical Clearance:

Study was conducted in accordance with ethics research comity and ethical clearance was obtained from ethics research comity of institutional review board.

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