

# Clinical Profile and Outcomes of Rodenticide Poisoning in Tertiary Care Hospital

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**Abstract-** Poisoning is a major problem all over the world, although its type and the associated morbidity and mortality vary from country to country. Most of the poisoning cases are suicidal in nature. Rodenticides are pesticides specifically used to kill rodents. Rodenticide poisoning has varied incidence across the country. Rodenticide poisoning remains a major public health problem in Asian countries.(1) The mortality rates also vary significantly.

Rodenticides can be classified into Warfarin and related compounds (Coumarins and Indandiones), Inorganic compounds (thallium, arsenic, zinc phosphide, aluminium phosphide and yellow phosphorus) and Convulsants (strychnine). The incidence of rodenticide poisoning and mortality rates varied significantly in studies conducted in North and South India.(2) Nevertheless, very few data are available in world literature regarding the outcomes of these patients. Therefore, the purpose of this study was to investigate the clinical outcomes of rodenticide poisonings in our hospital.

## METHODS:

- Our study is a Cross sectional study.
- The study was conducted in Kasturba hospital, Manipal. Kasturba Hospital is a 2032 bedded, specialty and super-specialty medical and surgical care centre. Patients with age greater than 18 years and those satisfying the inclusion criteria were included in the study.
- From cases a detailed history and physical examination with review of charts was obtained as relevant to the present study. A standard proforma as detailed below was used and the data of all the patients was entered after obtaining informed consent. This study has been approved by the institutional ethics committee.

**Study period:** August 2012 to August 2014.

- A total of 97 cases of rodenticide poisoning were recorded during the study period.
- Patients who consumed Warfarin compounds, Aluminum phosphide, Zinc Phosphide, Thallium, Arsenic with age more than 18 years and diagnosed as per ICD-10 code T 60.4 were included in our study.

## Findings:

- Among the patients presenting with Rodenticide poisoning, most common was ingestion of Yellow

Phosphorous, Zinc Phosphide followed by Superwarfarins and Aluminium phosphide.

- Patients who presented early and started on N Acetylcysteine had good prognosis.
- Patients who presented with consumption Superwarfarin had excellent prognosis.
- MELD score can be considered as good prognostic indicator in patients presented with hepatotoxic rodenticide poisoning.

## Interpretation:

Early treatment of patients of rodenticide poisoning with N-Acetylcysteine may provide favourable prognosis.

MELD score can be used as a reliable prognostic indicator in patients with hepatotoxic rodenticide poisoning.

**FUNDING:** None

## I. INTRODUCTION

Poisoning is major global health problem worldwide. It can be suicidal, accidental, and 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 Asia.(3, 4) In 1990, jeyaratnam estimated that self-harm resulted in 2million cases of poisoning each year with 200000 deaths. In contrast, accidental and occupational exposure were estimated to cause 1 million cases with 20 000 deaths.(5) Studies have shown that deliberate self-poisoning has a far higher mortality than accidental poisoning.(6, 7) Organophosphates, pesticides are most commonly used poisonings for suicide.

A pesticide is usually defined as a chemical substance, biological agent, antimicrobial or disinfectant used against pests including insects, plant pathogens, weeds, molluscs, birds, mammals, fish, round worms and microbes that compete with humans for food, destroy property, have a propensity for spreading or are a vector for disease or simply a nuisance. The types of pesticides commonly used are also called

- Insecticides.
- Herbicides.
- Fungicides.
- **Rodenticides.**

## **RODENTICIDES:**

- Rodenticides, pesticides specially designed to kill rodents, pose particular risks for accidental poisoning for several reasons. Since they have been designed to kill mammals, they are also toxic to humans.
- Because rodents usually share human environments, use of rodenticides poses an inherent risk of exposure to people, particularly children and their pets, as well as other non-target species. **They are among the most toxic compounds regularly found in homes.**
- Rodenticide poisoning has varied incidence across the country. The mortality rates also vary significantly. The type and quantity of poison consumed, lack of a specific antidote for some of the rodenticides and time lapse in treatment affect the outcome.

## **CLASSIFICATION OF RODENTICIDES:**

### Who classification

1. Warfarin
2. Warfarin like compounds (brodifacoum, chlorphacinone, difenacoum, diphacinone, bromadiolone )
3. Calciferol (cholecalciferol, ergocalciferol)
4. Fluoroacetates  
(Sodium fluoroacetate, Fluoroacetamide)
5. Metal phosphides (phosphorus, aluminium phosphide, zinc phosphide, magnesium phosphide, yellow phosphorous )
6. Chloralose
7. Others (arsenic, thallium, strychnine)

## **CLASSIFICATION OF RODENTICIDES BASED ON TOXICITY:**

### **HIGHLY TOXIC RODENTICIDES:**

Highly toxic rodenticides are those substances with a single dose LD50 of less than 50mg/kg body weight. Some of these compounds have largely been abandoned because of serious human toxicity. This group includes

1. Aluminium phosphide
2. Sodium monofluoroacetate,
3. Strychnine,
4. Zinc phosphide,
5. Yellow phosphorus
6. Arsenic.
7. Thallium

### **MODERATELY TOXIC RODENTICIDES:**

Among the moderately toxic rodenticides, those with LD50 of more than 500 mg/kg body weight are

1. alpha-naphthyl-thiourea (ANTU)
2. DDT.

Patients who ingest large quantities of ANTU may develop dyspnea, rales and cyanosis (secondary to pulmonary edema) and hypothermia. Poisoning from exposure to DDT can result in symptoms such as vomiting, tremors and convulsions. How much exposure is required to cause severe illness or even death is however, not certain.

## **LOW TOXICITY RODENTICIDES:**

Low toxicity rodenticides are those with LD50 between 500 and 5,000 mg/kg body weight and include

1. Red squill.
2. Norbomide.
3. Anticoagulants warfarin-type rodenticides.

### **1. Red squill:**

Red squill contains several compounds with chemical and pharmacological properties similar to those of digitalis glycosides. Because of its emetic properties, poor gastrointestinal absorption and decreased potency (compared to that of digitalis), red squill has seldom been associated with human toxicity.

### **2. Norbomide:**

Norbomide is an irreversible smooth muscle constrictor. It causes widespread ischemic necrosis and death in rats but does not appear to affect other animals or humans, presumably due to the presence of a specific smooth muscle norbomide receptor found only in rats.

## **MATERIALS AND METHODS:**

### **Study Design:**

This is a Cross sectional study.

### **Study Area & Study Population:**

- The present study was conducted in Kasturba hospital, Manipal. Kasturba Hospital is a 2032 bedded, specialty and super-specialty medical and surgical care centre. Patients with age greater than 18 years and those satisfying the inclusion criteria were included in the study.
- This study has been approved by the institutional ethics committee.

**Study period:** August 2012 to August 2014.

### **Inclusion criteria:**

- Diagnosis as per ICD-10 code T 60.4
- Patients who consumed Warfarin compounds, Aluminum phosphide, Zinc Phosphide, Thallium, Arsenic.
- Age  $\geq$  18 years.

### **Exclusion criteria**

- Patients who consumed Rodenticide mixed with other poisonous compounds (OP compounds, others).
- Patients who have h/o Liver disease.

### **METHODOLOGY:**

- From cases a detailed history and physical examination with review of charts was obtained as relevant to the present study. A standard proforma was used and the data of all the patients was entered after obtaining informed consent.

### **STATISTICAL ANALYSIS**

Continuous variables are expressed as means and standard deviations and categorical variables as numbers with percentages in brackets.

For comparisons between patient groups, we used Student's T test for quantitative variables and Chi-square or Fisher's exact tests for categorical variables.

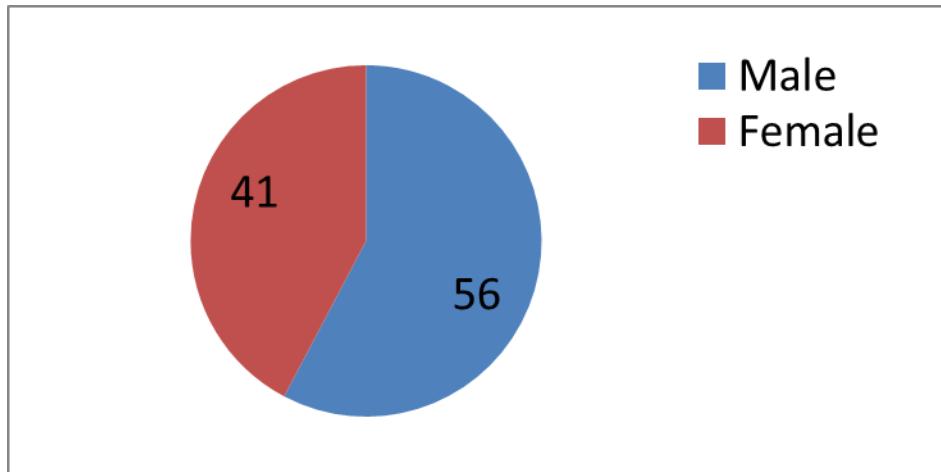
P<0.01 was taken as significant.

Data analysis and interpretation was done with IBM SPSS Statistics v20.0.

**OBSERVATIONS AND ANALYSIS:**

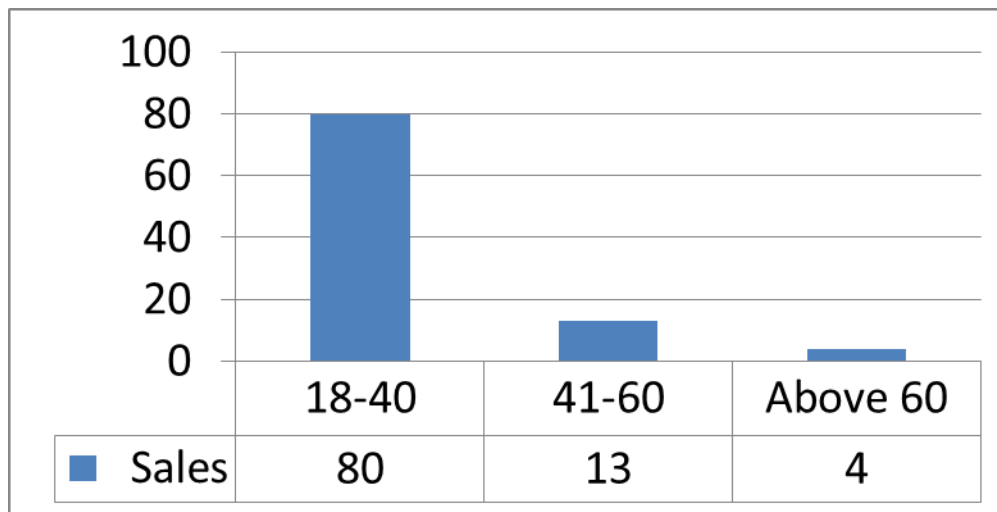
- A total of 97 cases of rodenticide poisoning were recorded during the study period.
- All Patients came to KMC, Manipal with consumption of Rodenticide poisoning.

**Figure 1: Sex distribution**



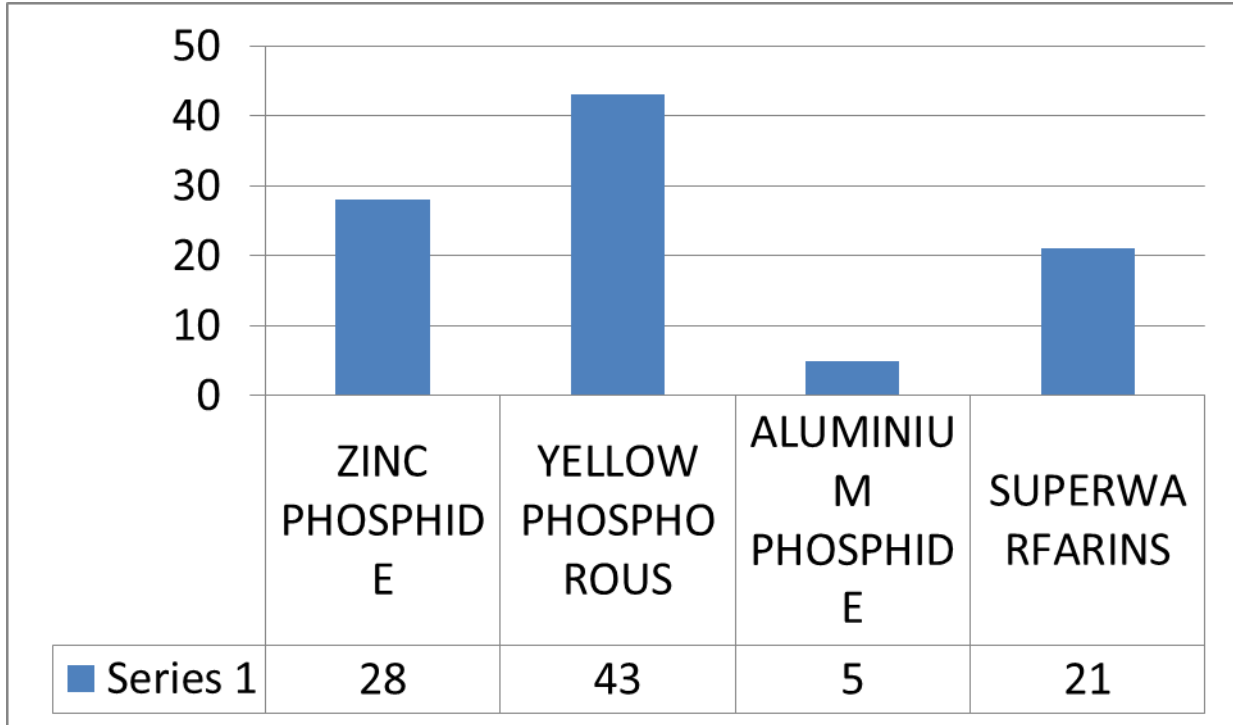
- 1.) Males-56(57.7%)
- 2.) Females-41(42.3%)

**Figure 2: Age distribution:**

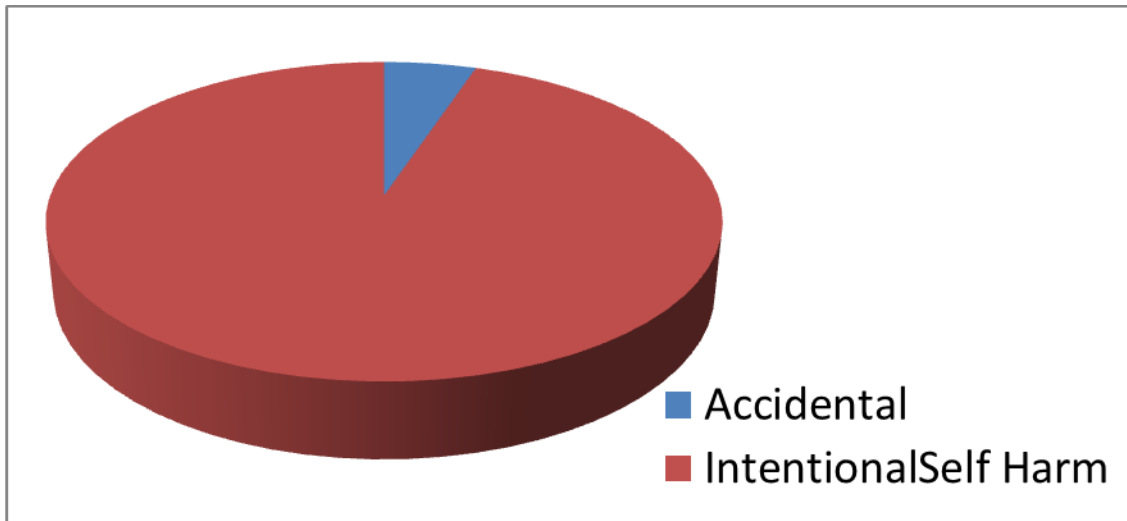


- 1.) 18 to 40yrs 80 patients (82.5%)
- 2.) 41-60yrs 13patients (13.4%)
- 3.) Above 60yrs 4 patients (4.1%)

**Figure 3: Chemical compound distribution**



**Figure 4: mode of poisoning**

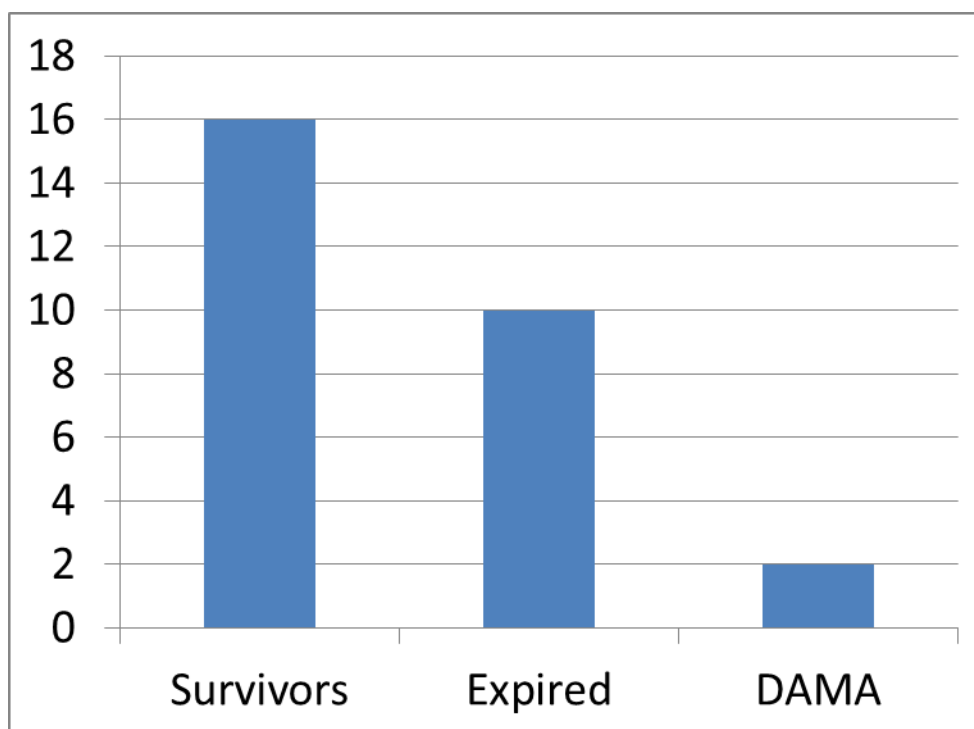


Accidental 5 (5.2%)  
Intentional self-harm 92(94.8%)

**Table 1: VARIABLES EFFECTING OUTCOME**

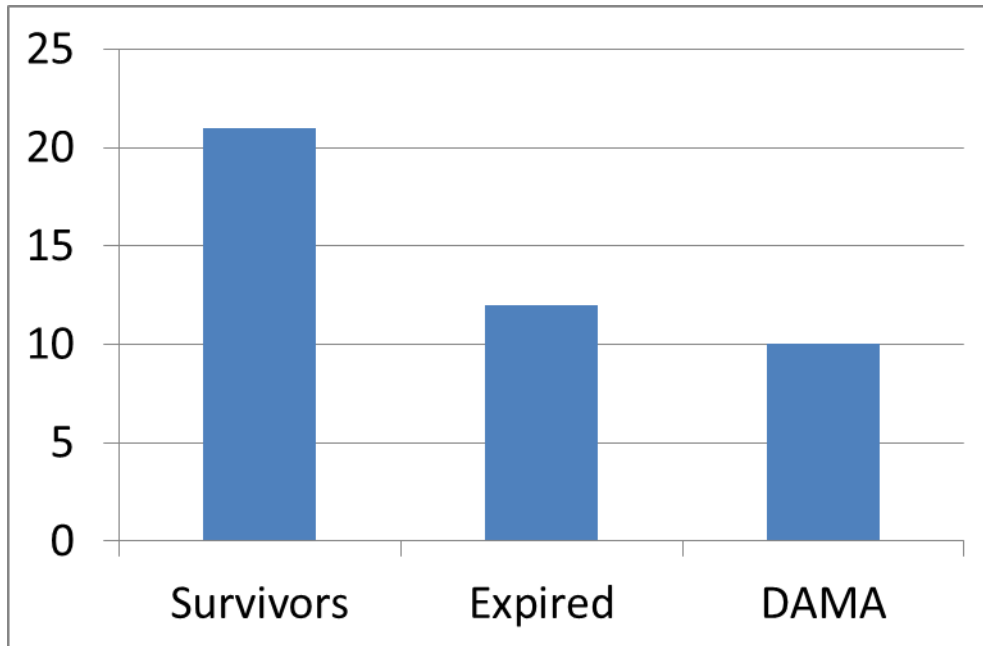
Variable	Survivors	Non survivors + DAMA
Marked elevation of liver enzymes (27)	3 (11.1%)	24(88.9%)
Mean value of bilirubin	2.84	11.81
INR > 1.5 (36 )	12 (26.6%)	33(73.3%)
Metabolic acidosis (25)	2 (8%)	23 (92%)
Hypotension (20)	2(9.1%)	18 (90.9%)
Mechanical ventilation (22)	2 (10%)	20 (90%)
Hepatic encephalopathy (29)	4(13.7%)	25 (86.2%)
Bleeding manifestations (19)	3(23.1%)	16(76.9%)

**Figure 5: Zinc phosphide poisoning-outcome:**



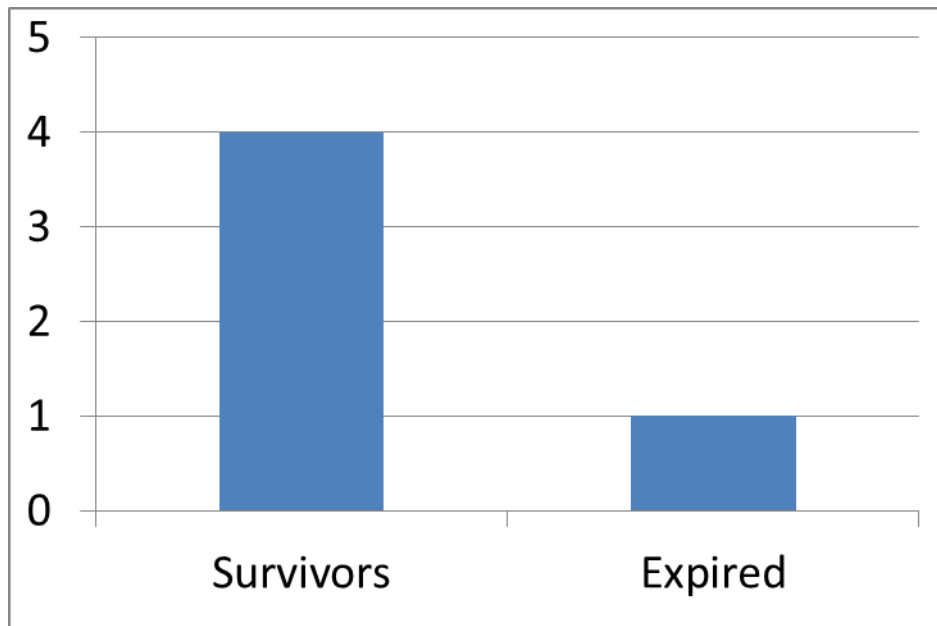
- 1- Survivors 16(57.1%)
- 2- Non survivors 10(35.7%)
- 3-DAMA (Discharge against medical advice) 2(7.1%)

**Figure 6: Yellow phosphorous poisoning-outcome**



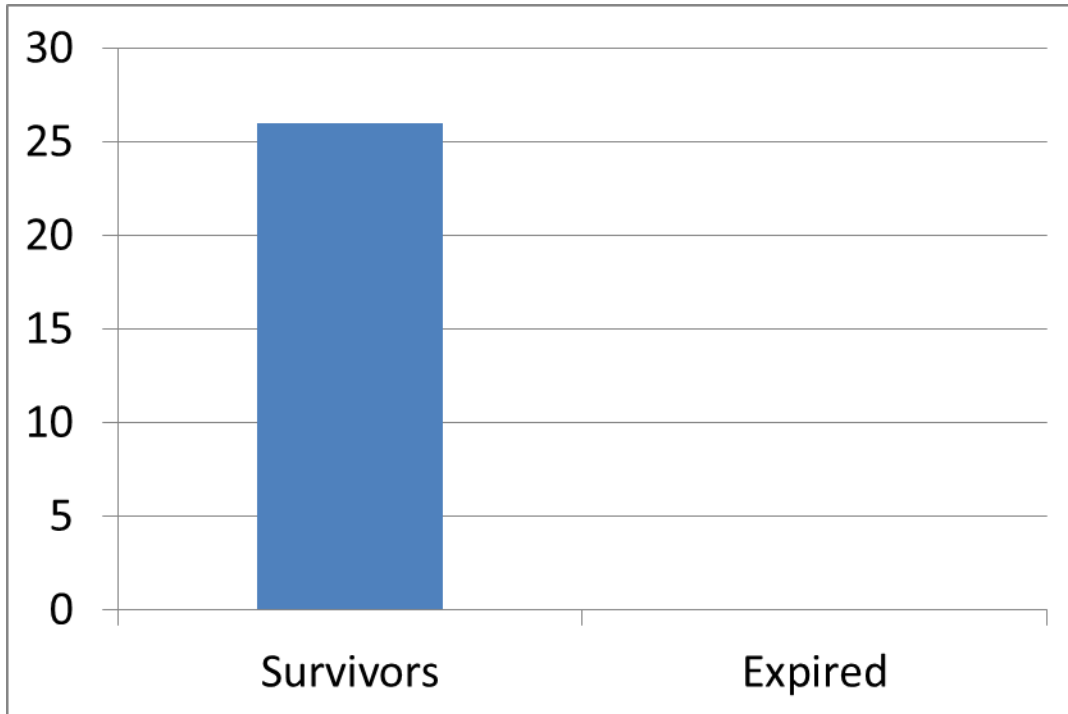
- 1-Survivors 21(48.8%), 2- Expired 12(27.9%) and 3-DAMA (Discharge against medical advice) 10 (23.2%)

**Figure 7: Aluminium phosphide-outcome**



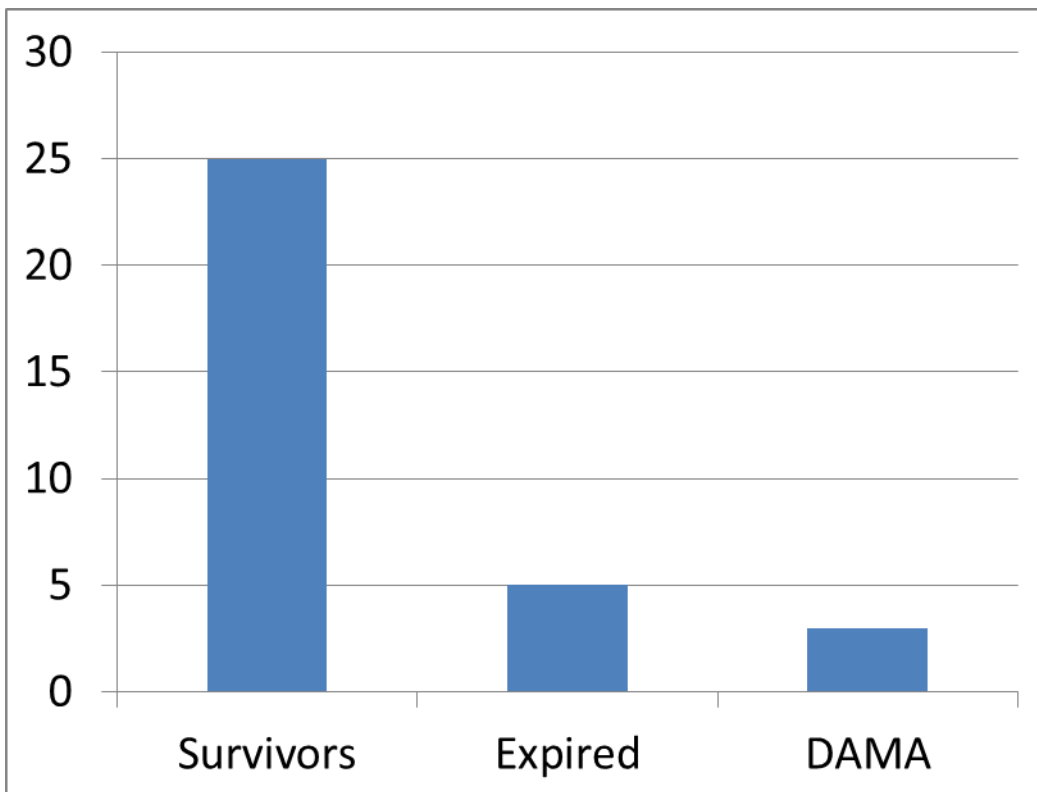
- 1.) Survivors 4 (80%)
- 2.) Expired 1 (20%)

**Figure 8: Super warfarins – outcome**



- 1.) Survivors 26(100%)
- 2.) Expired 0(0%)

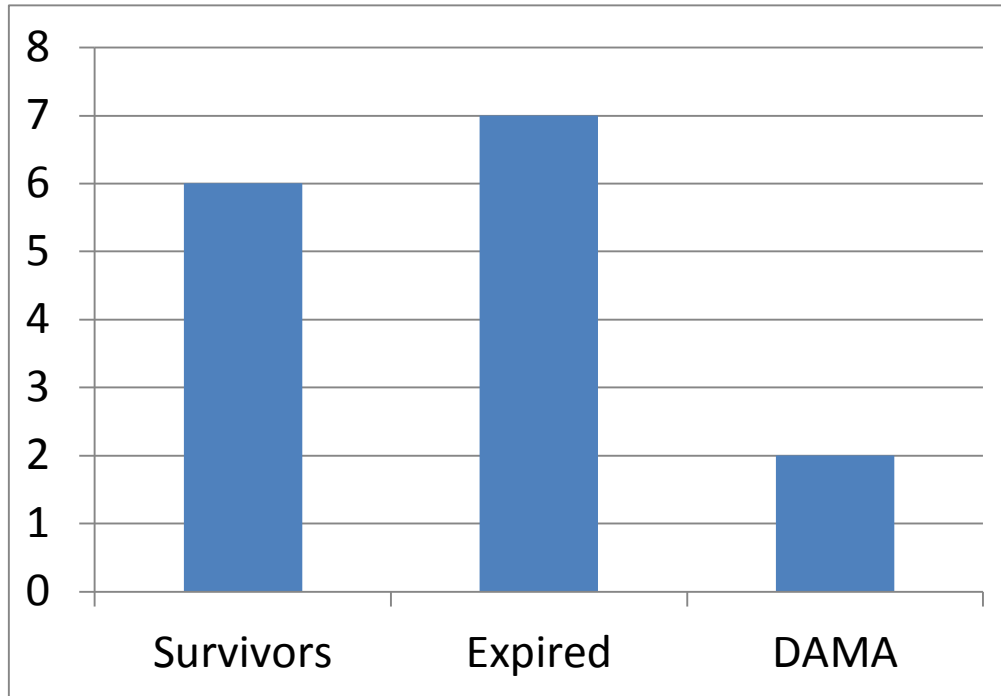
**Figure 9: N- acetylcystine started on day 1 –outcome**



- 1.) Survivors=25patients, 76.4%
- 2.) Expired=5patients, 14.7%

3.) DAMA=3patients, 8.8%

**Figure 10: N acetylcystine started on day2 –outcome:**

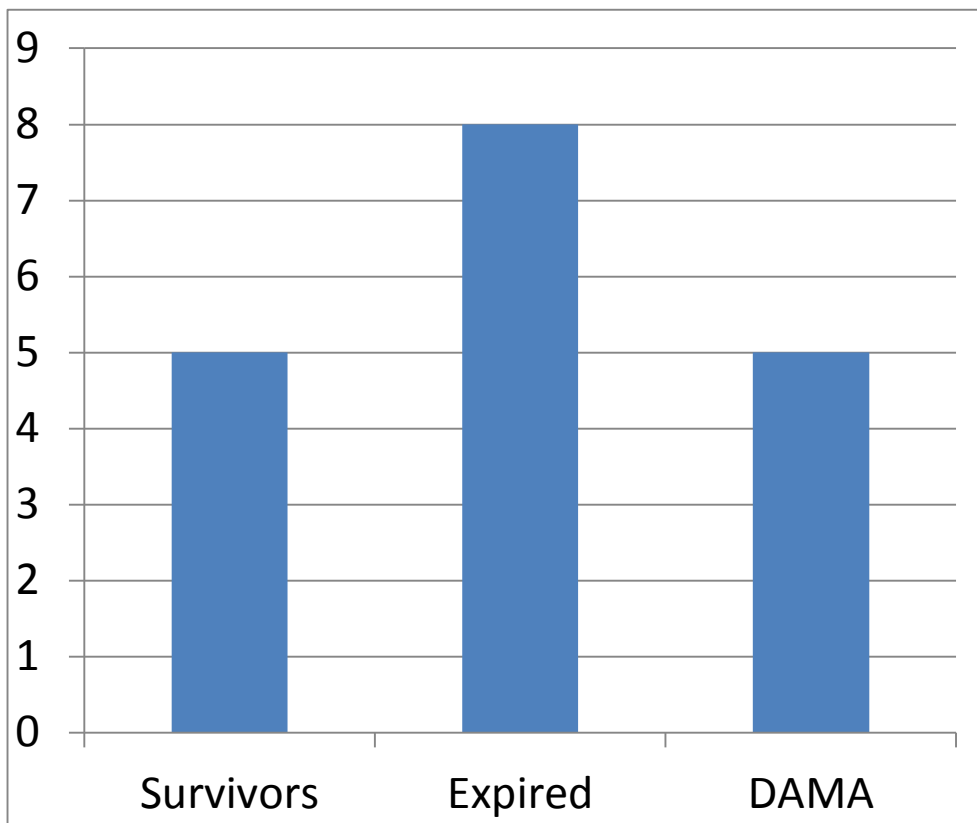


1.) Survivors =6, 40%

2.) Expired =7, 46.6%

3.) DAMA =2, 13.3%

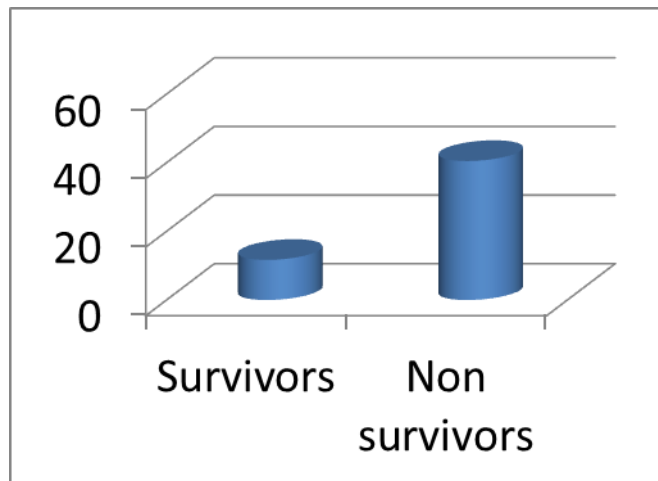
**Figure 11: N acetylcystine started after 2days-outcome:**





- 1.) Survivors=5, 22.7%
- 2.) Expired=8, 45.4%
- 3.) DAMA=5, 31.8%

**Figure 12: Mean value of MELD score**

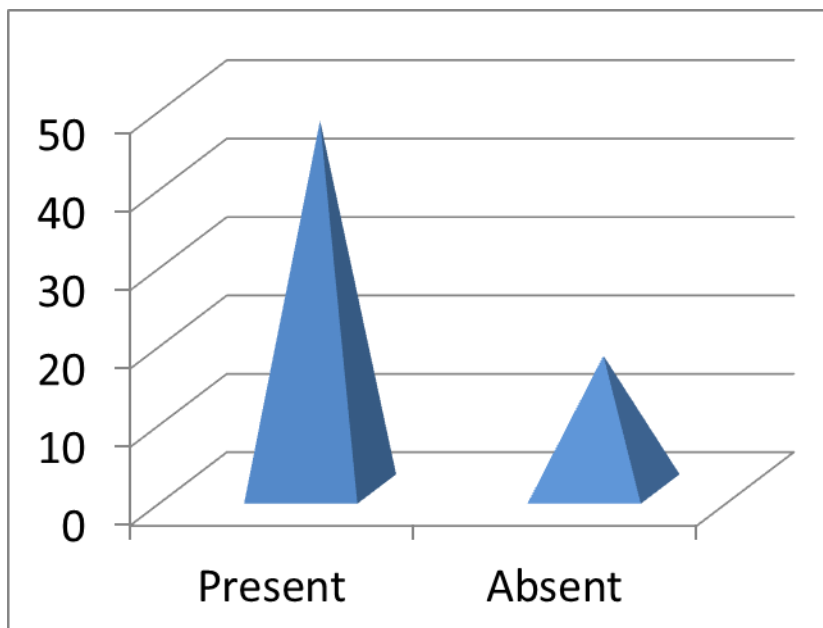


- 1.) Survivors-11.7 , 2) Non survivors-40.52

**Table 2: MELD (Model of end stage liver disease) score outcome**

MELD SCORE	Survivors	Non survivors	DAMA
<9	17(100%)	0	0
10-19	10 (90.9%)	1 (9.1%)	0
20-29	7(53.8%)	3(23.1%)	3(23.1%)
30-39	2 (50%)	1 (25%)	1 (25%)
>40	0	16(76.1%)	5 (23.8%)

**Figure 13: Psychiatric diagnosis:**



- 1.) Present-47(73.4%),
- 2.) Absent-15(26.6%)

## II. DISCUSSION

- Rodenticide compounds are commonly used to kill rats, mice and rodents. They are heterogeneous group of compounds that exhibit markedly different toxicities to Humans and Rodents.
- In our study we noticed that in areas, in and around Udupi, commonly available Rodenticide compounds are Yellow phosphorus and zinc Phosphide (highly toxic) and Superwarfarins (low toxic).
- In our study, most of the patients ingested Phosphorous compounds. Out of 97, 43 (44.3%) Yellow Phosphorous, 28 (28.8%) Zinc Phosphide, 5 (5.1%) Aluminium Phosphide and 21(21.6%) Superwarfarin (0.005% Bromadiolone).
- In a Retrospective study conducted in south India in the year 2002, Organic Phosphorus compounds were reported as the most common cause of poisoning (36.0%) followed by Snake bite (16.2%), Drugs (11.0%), Rat poison (7.3%) and Others.(2)
- A prospective study conducted from 2008-2010 in West Bengal ,( total 4,432 patients ) Snakebite (31.90%) was the most common cause of poisoning followed by Organophosphorus compounds (21.84%), Rodenticide (16.49%), Alcohol (13.80%), Chemicals (9.04%), and Drugs (2.3%).(8)
- Recently Rodenticide poisoning study conducted in Rajasthan, Kota Medical College 2012 , where patients presented with consumption of following compounds Dicoumarol 47(27.6%),

Superwarfarins 24 (14.12%) and Zinc phosphide 18 (10.59%).

- Out of 97 Patients Males 56 (57.7%) and Females 41 (42.3%) which slightly more incidence in Males.
- In this study majority of patients are suicidal 92(94.8), and only 5 (5.2%) patients presented with accidental ingestion
- Out of 95 patients who attempted suicide, 80 (82.5%) is younger age group 18 to 40years.
- Various studies on poisoning done in India Indranil Banerjee et al in west Bengal, K N ramesha et al in Karnataka and gupta S et al in Gujarat also noticed most commonly effected age group was 20 – 40yrs.(2, 8)
- Among 62 patients recovered from acute poisoning 47 (73.4%) members were diagnosed to have Psychiatric disorder. Majority of the patients had Depression and Adjustment disorder.

### Clinical Profile:

- We found that, in Rodenticide poisoning common GI side effects like nausea, vomiting is seen in 83 members (85.7%) and Abdominal pain in 55 (56.7%). These findings are comparable to previously done studies.
- Bleeding manifestations are seen in 16(16.4%), Icterus is seen in 46(46.3%) and Altered Sensorium seen in 29(29.8%).
- Patients who came with ingestion of phosphorous compounds have high mortality, initially they developed acute liver failure and later progressed to multisystem organ failure.

**Table 3: Showing parameters with significant difference between survivors and non survivors.**

Parameter effecting outcome	Non survivors (%) (with p<0.01)
• Marked elevation of liver enzymes	• 24(88.9%)
• Prolonged prothrombin time	• 33(73.3%)
• Metabolic acidosis	• 23(92%)
• Hypotension	• 18( 90.9%)
• Bleeding manifestations	• 16(76.9%)
• Hepatic encephalopathy	• 25(86.2%)

In our study, three of our patients who came with consumption of zinc phosphide had Acute Pancreatitis. Sarma et al. have reported that zinc phosphide ingestion leads to Acute Pancreatitis.(9)

**Outcome of Zinc Phosphide:**

- In our study we noticed that, mortality in patients who presented with ingestion of Zinc Phosphide was 35.7% and patients who lost follow up 7.1%.
- Study done by chugh et al on zinc phosphide showed mortality of 25%.(10)
- Study done in Turkey by Mehmet Tahir Gokdemir et al showed mortality of 28.3%.

**Yellow phosphorous:**

- Patients who presented with consumption of Yellow Phosphorus, mortality was 27.9% and patients who lost follow up 23.2%.
- The fatality rate in Yellow Phosphorous poisoning from previous studies been reported between 10 and 50%.(11)
- Fernandez and Canizares stated that in a series of 15 patients observed a mortality of 27% is recorded, confirming that Yellow Phosphorus is extremely lethal when ingested.(12)

**Superwarfarins:**

- Patients who came to emergency with consumption of Bromadiolone had only deranged Prothrombin time was noticed in 14.3% of patients but no mortality was recorded.
- Similar results are seen in a study done in 2012 by Manish Pahadia et al in India. In this study it is observed that 26 patients who consumed Bromadiolone had only bleeding manifestation, and all patients survived.
- Study on Superwarfarins done in Taiwan by Hsin-Ying Yu et al in 2013, 20 patients was noticed. Prolonged PT seen in 20% of patients and mortality rate was zero.(13)

**Role of N-Acetylcysteine**

- We have noticed good prognosis in patients who have been started early on N acetylcysteine therapy after consumption of poisoning.

- Patients who presented on 1<sup>st</sup> day of consumption have 76.4% survival, presented on 2<sup>nd</sup> day have 40% survival and presented after 2days only 22.7%.
- This is mainly because of gastric lavage given to those patients presenting early, which decreases the amount of rodenticide entering circulation and early treatment with N acetylcysteine.
- N Acetylcysteine has significant role in Acute Liver injury. This is probably attributed to the Anti-oxidant property and Hepato- protective nature of NAC.
- Role of NAC in Yellow Phosphorous has been quoted in some journals and texts.(14)
- A study conducted at Vinayaka Mission Hospital, Salem from 2010 to 2011, concluded the use of NAC as an adjuvant in the management in Yellow Phosphorus poisoning.

**MELD score as prognostic indicator**

- The Model of end stage liver disease (MELD) score was originally designed for assessment of short term prognosis in patients with Chronic liver disease.(15)
- Recently MELD score has also been used to determine the prognosis in patients with Acetaminophen and Non Acetaminophen induced Acute Liver injury(ALI).(16)
- We noticed that mean value of MELD score in survival 40.52 and non survival patients 11.7 which is significant (p value<0.001).
- Om prakash et al done a study(2005-2007) to compare MELD score and King’s College Hospital criteria in Non Acetaminophen ALI, in this study patients who died have mean value of MELD score 35.35 which can be compared to our study 40.52.

**III. CONCLUSION**

- Among the patients presenting with Rodenticide poisoning most of them presented with ingestion of Yellow Phosphorous, Zinc Phosphide followed by Superwarfarins and Aluminium phosphide.
- Patients who presented early and started with N Acetylcysteine had good prognosis.

- Patients who presented with consumption Superwarfarin had excellent prognosis.
- MELD score can be considered as good prognostic indicator in patients presented with hepatotoxic rodenticide poisoning.

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