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ROLE AND EFFECTS OF N-ACETYLCYSTEINE IN RAT KILLER (RODENTICIDE) POISONING

J. Chandravanshi[1] A. Kori [2] P. Tembhurnikar[3] A. Thakur[4]
1. Assistant Professor, Department of Medicine, Chhattisgarh Institute of Medical Science (CIMS), Bilaspur, Chhattisgarh, India.
2. Assistant Professor, Department of Medicine, Chhattisgarh Institute of Medical Science (CIMS), Bilaspur Chhattisgarh, India
3. Professor and Head of the Department, Department of medicine (CIMS) Bilaspur, Chhattisgarh, India.
4. Associate Professor Department of Medicine, (CIMS) Bilaspur, Chhattisgarh, India.

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Corresponding author*
Dr. J. Chandravanshi

ABSTRACT

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Introduction: - Rodenticide is one of the pesticides and heterogeneous substances used to kill rats. Rodenticide poisoning is a major health problem in Asian countries, particularly the mode of self-poisoning, prevalent in India. It causes hepatotoxicity and no antidote has been found. N-acetylcysteine (NAC) is a powerful antioxidant and used in the treatment of acetaminophen-induced hepatotoxicity. The main objectives of this study were to determine the role of NAC in liver impairment rodenticide poisoning patients.
Methods: - Patients who ingested rat killer poison and age >15 years were included in the study. Patients having jaundice, liver disease, and age <15 years were excluded from the study.
Results: - Out of 50 patients. 27 (54%) were females and 23 (46%) were males. Age group between 21-30 years contributes the highest 20 (40%). The majority of types of rodenticide compounds consumed by patients were paste 29 (58%) and less than four hours 26 (52%) patients were admitted. and 7 (14%) patients died.
Conclusion:-In liver impairment rodenticide poisoning patients, early use of NAC shows a significant result and the rate of recovery is also high.

INTRODUCTION

Rodenticides, commonly referred to as "rat poisons," are chemical agents aimed at eliminating small rodents. The common targets for their use are household rodents i.e. rats/mice, squirrels, gophers, etc. Controlling rodents is imperative as they are vectors for the spread of disease, destroy crops/grains, and multiply rapidly. [1]

Mode of Poisoning

Ingestion—This is the most common mode reported. It may be accidental or

intentional. Accidental consumption is more commonly noted in the pediatric age group. Inhalation—This is especially seen with phosphine gas that is produced as a result of metal phosphides reacting with water. Dermal route—Although very rare, poisoning by this route has also been reported. [2]

They are easily available in the Indian subcontinent and are common agents in deliberate self-harm, especially among the agricultural community. The high fatality due to ALF (Acute liver failure) induced by rodenticides makes the need for an antidote urgent and imperative. Aluminum phosphide (AlP) and zinc phosphide are the hepatotoxic forms of rodenticide. In our center, cases admitted with rodenticide consumption were mainly from the agricultural community, and many of them were young. Rodenticide consumed in patients admitted to our center was mainly a compound of aluminum phosphide, zinc phosphide, and yellow phosphorus. Patients presented most commonly with symptoms of GI toxicity including vomiting and abdominal pain. [3] This poisoning is associated with high mortality. The good prognostic factors are survival after 3 days and minimal elevation of LFT. Bad prognostic signs are altered sensorium, cyanosis, hypotension, metabolic acidosis, elevated prothrombin time, and hypoglycemia. [4]. The first phase consists of nausea, vomiting, abdominal pain, and smoking stools. Then, in the second phase, the patient may feel symptomatically better and the third stage consists of systemic organ damage due to absorbed phosphorous. Hepatotoxicity usually is recognized on the 3rd day by liver function test (LFT). [5] A large number of early deaths <24 h are due to cardiotoxicity. Renal toxicity is due to acute tubular necrosis which may be due to hypotension. Hyponatremia, hyperkalemia, and hyperphosphatemia are observed. Furthermore, there is no antidote for this poisoning. [6] N-acetylcysteine is used as an antidote in paracetamol poisoning. Since its mechanism of hepatoprotective is similar, it can also be used in yellow phosphorous poisoning. [7] N-acetylcysteine has been used in many of non-paracetamol-induced acute liver failure. N-acetylcysteine through replenishment of glutathione stores of superoxide dismutase (SOD) is proposed to have a beneficial effect. It replenishes the free radical scavenging system of hepatocytes and also directly neutralizes the free radicals. It is also said to improve cerebral perfusion in fulminant hepatic failure in rats. Elevation of liver enzymes occurred usually on the 2nd to 3rd day after admission. [8] This is fairly typical with phosphorus poisoning, and patients must continue to receive intensive monitoring and care during and after the first three days following ingestion, even if overt signs of hepatotoxicity are absent. In our study, the liver was the main organ involved, and serum creatinine at presentation was normal in all patients studied. [9]

METHODS

This study was conducted among 50 patients admitted with ingestion of rat killer poison in the Department of Medicine, Chhattisgarh Institute of Medical Sciences, [C.I.M.S] Bilaspur Chhattisgarh, from January 2020 to September 2020. This study is a prospective analytical study. Patients who ingested rat killer poison and age >15 years were included in the study. Patients are having jaundice, liver disease, congestive cardiac failure, patients on hepatotoxic drugs, and age <15 years were excluded from the study. Demographic details, medical history, and clinical examination were recorded. Complete blood count, blood sugar, renal function test, LFT, prothrombin time / international normalized ratio, and electrocardiography (ECG), and ultrasound abdomen were done. Patients were treated with N-acetylcysteine at the dosage of 150 mg/kg in 200 ml 5% D over 15 min and 50 mg/kg in 500 ml 5% D over 4 h and 100 mg/kg in 2000 ml 5% D over 16h.

There is no specific dosage of N-acetylcysteine for rat killer poisoning patients. Since N-acetylcysteine is used for many non-paracetamol causes of liver failure, we used N-acetylcysteine and there is no harm to patients. LFT was done daily until discharge to monitor the development of liver failure. There was no delay in starting the N-acetylcysteine after admission.

RESULTS

A total of 50 patients were included in this study. Among them 27 (54%) were females and 23 (46%) were males (Table2) and age group between 21-30 years constituted the major contributors for the rodenticide poisoning 20 (40%) followed by 31-40 years were 11(22%) Show in the (Table -3). The majority of compound types of rodenticide consumed by patients were paste 25 (50%) followed by powder 15 (30%) and cake were 10 (20%) (Table-4). The time duration between poison ingestion and hospitalization analysis shows that most of the patients were admitted. To the hospital, less than six hours 38(76%) and only 12 (24%) were admitted after 6hours of poison ingestion (Table1).

Among 50 patients studied, seven patients died, nine patients developed hepatitis, two patient developed acute kidney injury with hepatitis, and Two patient developed hyponatremia of the patients developed a complication, NAC was started within 6 h for 38 patients, 13 patients had complications, of which 3 died and NAC was started in >6–10 h for 6 patients, 3 had complications, of which 2 died and NAC was started in >10 h for 6 patients, 2 had complications and died. In our study, of the 50 patients studied, 18 patients (36%) developed complications and in that 7 patients (14%) died. When comparing the time interval between starting of antidote and consumption of poison, 34% of patients developed complications and 23.76% of those patients died in <6 h group, but in 6–10 h group, 50% developed complications and mortality was 66.66% whereas in >10 h group, patient (33.33%) developed complication and died (100%).

Table 1: Correlation of time interval between the consumption of poison and starting of N-acetylcysteine with the development of complications

Time of starting N-acetylcysteine	Number of patients	Number of patients developed complications	Number of patients died after complication
<1h	4	0	0
1-2h	6	3	0
2-3h	6	2	0
3-4h	10	4	2
4-5h	5	2	0
5-6h	7	2	1
6-10h	6	3	2
>10h	6	2	2

Table 2:- Gender wise distribution of patients

Gender	No. Of patients	Percentage
Female	27	54
Male	23	46

Table 3: - Age-wise distribution of patients.

Age (in years)	No. of Patients	Percentage
16-20	10	20
21-30	20	40
31-40	11	22
41-50	6	12
51-60	3	6

Table 4: - Type of rodenticide poisoning

Compound Type	No. of Patients	Percentage
PASTE	25	50
POWDER	15	30
CAKE	10	20

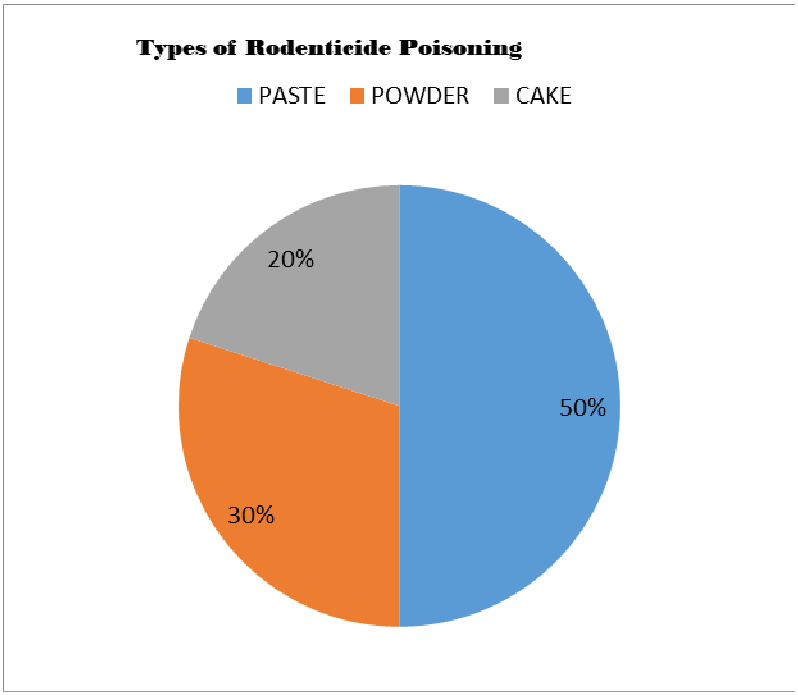

Fig 1: Types of rodenticide poisoning

DISCUSSION

Poisoning is a major health problem worldwide. 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 [10] pesticides like rodenticide are a heterogeneous group of compounds usually intended for killing rats and mice. These compounds, however, show sharply distinctive toxicities among humans and rodents.[11] A total of 50 patients were analyzed, among them females 27 (54%) were higher than males 23 (46%) and it was similar to Seetha 33 (58.92%).[12] Based on age-wise distribution, 16-20 years were 10 (20%) and 21-30 years were 20 (40%) contributes 60% of the total study population and it correlates with the study conducted by Srinivasa et al constituted the major contributors 19-30 years (48.1%). And 51-60 years (6%) were the least contributors in our study, as in a study

by Balasubramanian et al (2.50%). [13] Based on the type of rodenticide poison ingestion, intake of rodenticide paste poison constitutes 25 (50%) and it coincides with the study conducted by Saravanan because their study is on rat killer paste poisoning and their sample size was 30 patients. [16] Time duration between poison ingestion and hospitalization were recorded and >4 hours 26 (52%) were admitted. So, administration of NAC is possible at the right time and the outcome of the patient is better and it is somewhat similar to the study by Srinivasa et al <2 hours 64%. Shukkoor et al tell that prompt use of NAC within the first 12 hr. of poisoning is beneficial [17]. Radhika et al study tell that symptoms were developed after 5 to 6 hours of poison ingestion. In contrast, Saoji et al found in their study that the patients were usually asymptomatic during the initial 72 hours of ingestion. [18] Saravanan found that with the early use of N-acetylcysteine therapy in rat killer paste poisoning, overall mortality has been reduced. Kharkongor et al it was noted that survival was greater among patients who received NAC early, compared to those who received it later during illness. [19] Patients with abnormal liver function tests like total bilirubin, direct bilirubin, SGOT/AST, SGPT/ALT, alkaline phosphatase, and prothrombin time and INR were analyzed and most patients were treated with NAC and the outcome of the patients were better [8]. This result correlates with the study done by Radhika et al tells that 100% of patients received treatment with NAC [9]. Kharkongor et al tell that after ivy. administration of NAC, serum AST and ALT level improved. Mishra et al also reveal the best results were seen among patients treated with NAC in the early course of illness. [20]

CONCLUSION

Our study finding reveals that early use of NAC therapy in rodenticide poisoning patients shows a significant impact on the recovery of the patients. A high mortality results from no specific antidote for rodenticide poisoning; our study finding provides strong evidence that, to use NAC as early as possible in rodenticide poisoning patients to Improve the outcome of the patient**.**

CONFLICTING INTERESTS

The authors declared no conflicts of interest concerning the authorship and/or publication of this article.

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