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A Study on the Clinical Profile of Non-Organophosphorus Poisoning in a Tertiary Care Hospital

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Abstract

Poisoning is emerging as a very important global health issue particularly in agricultural countries like India. Although wide range of data is available on organophosphorus poisoning cases, studies and data are limited on non-organophosphorus compound poisoning like paraquat, rodenticide (zinc phosphide, yellow phosphorus, sodium monofluroacetate, fluroacetamide, arsenic, warfarins, and scilliroside etc.), pyrethroid, carbamate etc. The present study aims to study the clinical presentation and outcome of the non-organophosphorus poisoning cases. A cross sectional retrospective study was conducted at Assam Medical College and Hospital, Dibrugarh. In this study the data of the patients with non-organophosphorus poisoning admitted to Assam Medical College from July, 2022 to July, 2023 were collected and analysed. A total of 104 patients were included in the study and most patients belonged to the age group of below 30 years. Out of all the cases highest number patients presented with Paraquat poisoning (48.1%), while distribution of other cases was as follows- Phenyl (12.5%), Pyrethroid (23.1%), Rodenticide (10.6%), Carbamate (1.9%) and Organochloride (3.6%). Vomiting was the most common presenting symptom. Hepatic and renal impairment was observed only in the paraquat poisoning cases and it was also associated with high mortality rate (88%). Acute Hepatitis and Acute kidney Injury was quite common among paraquat poisoning patients and mortality was mainly observed in paraquat, rodenticide and carbamate poisoning cases. Comprehensive care and awareness among general public is necessary for prevention and better management of poisoning cases. Development of proper rational management guidelines is also pivotal for reducing mortality in these cases.

Keywords: Acute Hepatitis, Acute Kidney Injury, Herbicide, Insecticide, Mortality, Non Organophosphorus Poisoning

1. Introduction

Being an agricultural country, the use of different kinds of insecticides and herbicides is quite common in India and there is easy availability of these compounds in almost all the households. This is leading to the increase in cases of poisoning of these compounds which are hazardous to the human health. Although not as frequently discussed like the organophosphorus compounds, however the collective incidence of different kinds of non-organophosphorus poisoning is not uncommon in our country. Different hospitals of India very frequently receive poisoning cases with different non organophosphorus compounds. However, it has been observed that this field in toxicology

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has not received that much of attention compared to the organophosphorus compounds. Moreover, not much studies have been done on nonorganophosphorus compounds collectively although some individual studies are available on these compounds[1-7].

The most commonly encountered non-organophosphorus poisoning includes compounds like Paraquat, Phenyl, Organochloride, Rodenticide, Carbamate, Pyrethroids etc. Different individual studies done on these compounds have shown variation in mortality and morbidity among these compounds with worst clinical outcome in those with paraquat ingestion[1,3,7]. Paraquat is highly toxic to human and is widely used in agriculture as a contact herbicide. It is mainly available under the brand name Gramoxone[1]. The most commonly involved organs in paraquat poisoning are the lungs and kidneys. Since paraquat shares structural similarity with the naturally occurring polyamines it gets absorbed and accumulated in the alveolar cells which leads to alveolitis and fibrosis of the lungs[8]. Paraquat also accumulates in the proximal tubular cells of kidney and which in-turn causes renal tubular necrosis. The cause of death in most of the cases are due to lung injury or multiorgan failure[9].

Pyrethroid compounds are widely used as insecticides and accounts for around a fourth of the insecticide market in industrial countries[10]. Pyrethroid compounds modify the action potential of voltage-sensitive sodium channels, and thereby delays their closure. This leads to a prolonged sodium influx (referred to as a sodium "tail current"), which if sufficiently large and/or long, lowers the action potential threshold, and causes repetitive firing[11]. Usually, pyrethroid poisoning rarely causes death or life-threatening situation. But severe poisoning with ingestion of large quantities of pyrethroid compounds can lead to Life-threatening manifestations like seizures, coma, pulmonary oedema, and haemorrhage[12]. Organochlorine pesticides belong to the group of chlorinated hydrocarbon derivatives and frequently used in agriculture. Its main mechanism of toxicity is by stimulating the central nervous system. The patients may present with seizures and altered sensorium along with other gastrointestinal systems like vomiting, diarrhoea etc[13]. Rodenticides as a group of pesticide comprises of different kinds of substance like yellow phosphorus, zinc phosphide, super-warfarin etc[2]. Older generation of rodenticides are known for causing haemorrhagic manifestations whereas newer generation compounds containing zinc phosphide or phosphorus can lead to hepatic and frenal failure[14,15].

Management of different non organophosphorus poisoning cases often becomes a difficult task considering the fact that most of the compounds do not have a specific antidote. Although mortality depends on multiple factors like the compound itself, amount ingested, duration of presentation to hospital etc. besides that timely intervention and rational management is also crucial in preventing death. This study aims to study the clinical profile of the non-organophosphorus poisoning patients admitted to Assam Medical College and Hospital and to assess the morbidity, mortality and Clinical outcome of the patients.

2. Materials and Methods

A retrospective observational study was conducted in Assam Medical College and Hospital, Dibrugarh, Assam. Data was collected on all the non-organophosphorus compound poisoning cases retrospectively who were admitted between July, 2022 to July, 2023. Patients who were aged 12 years or more with reliable history regarding the substance consumed or who were able to show the photo of the container, were included in the study. Patient's previous medical data was checked for baseline values of haematological investigations. Patients with known preexisting liver or renal disorders and also those patients who absconded from hospital in whom final outcome was not known, were excluded from the study. All the patients based on their clinical features, received treatment and care as per standard protocol for alleviation of symptoms.

2.1 Data Collection

After selecting the patients based on the inclusion and exclusion criteria their records were analysed and all the necessary data regarding demographic details, clinical manifestations, time duration between ingestion and presentation to hospital, duration of hospital stay, routine investigation reports including liver function test and renal function test and final outcome were recorded.

2.2 Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee (Human), Assam Medical College (No. 2023/AMC/EC/10793, Date: 19th October, 2023).

2.3 Data Analysis

Data are presented in numbers and percentages for qualitative values, in means and standard deviations for quantitative values. Data are analysed using the Statistical Package for the Social Sciences (SPSS) version 22.0. For outcome analysis, the level of significance was set at $P<0.05$.

2.4 Definitions

Acute Hepatitis: Acute hepatitis is defined as acute inflammation of liver with associated features like vomiting, anorexia, jaundice. In this study acute hepatitis is diagnosed on the basis of either elevated liver enzyme level or liver biopsy.

Acute Kidney Injury: Acute Kidney Injury is defined as an elevation in serum creatinine or reduction in urine output (A rise of serum creatinine by at least 0.3mg/dl within 48 hours from baseline or reduction in urine output to <0.5 ml/kg bodyweight/hour for longer than 6 hours.

3. Results

3.1 Demographic Parameters and Compounds Involved

A total of 104 cases were reviewed during a span of 13 months and the number of male and female patients were 54 and 50 respectively. Most of the patients were below the age of 30 years. Highest number of patients belonged to the age group of (21-30) years (35.6%) whereas only 6 patients (5.8%) were above the age of 50 years. In this study the frequently encountered non-organophosphorus compounds were paraquat, rodenticide, pyrethroids, organochloride, carbamate and phenyl.

Out of all the cases highest number patients presented with Paraquat poisoning (48.1%), while distribution of other cases was as follows- Phenyl (12.5%), Pyrethroid (23.1%), Rodenticide (10.6%), Carbamate (1.9%) and Organochloride (3.6%).

3.2 Clinical Manifestation

The patients presented with different kinds of complaints either isolated or in combination. It was observed that vomiting and pain abdomen were the most common presentations. Around 84.6% patients presented with vomiting and 81.7% patients had pain abdomen. Oral ulceration and odynophagia were also seen in 32.7% and 59.6% cases whereas 7 cases (6.7%) had shock at the time of initial presentation.

The duration of hospital stay was analysed in the patients who survived. The highest duration of hospital stay was observed in patients with paraquat poisoning (10.3 ± 3.6 days) whereas patients who consumed other substances were mostly discharged within 2-4 days. Biochemical abnormality in liver function test and renal function test was observed only in paraquat poisoning cases. Among 50 patients who ingested paraquat, acute

Table 1. Demographic characteristics of patients

Characteristics	Frequency	Proportion (%)
Gender distribution		
Male	54	52
Female	50	48
Age distribution		
12-20 years	28	26.9
21-30 years	37	35.6
31-40 years	17	16.3
41-50 years	16	15.4
51-60 years	3	2.9
> 60 years	3	2.9
Substance wise distribution		
Paraquat	50	48.1
Phenyl	13	12.5
Pyrethroid	24	23.1
Rodenticide	11	10.6
Organochloride	4	3.8
Carbamate	2	1.9

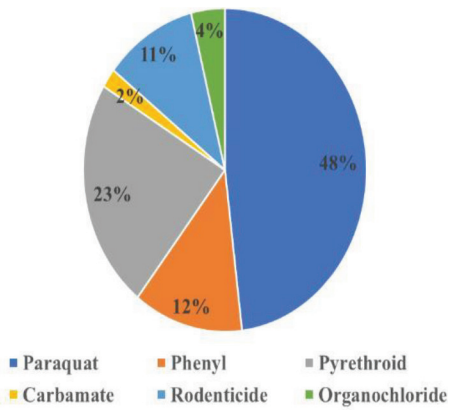


Figure 1. Substance wise distribution of cases.

hepatitis was found in 66% cases and 86% patients developed acute kidney injury.

3.3 Outcome

The final outcome of all the patients was also recorded. Overall, out of the 104 patients 50 patients expired (48.1%). It was found that all the patients with pyrethroid and phenyl poisoning survived whereas significantly high mortality rate was observed in paraquat (88%) and rodenticide (18.2%) poisoning. Although number of cases with carbamate poisoning was very low (n = 2) in our study, unfortunately both the patients expired.

An analysis was done to draw a relation between mortality and time duration between ingestion of poison and presentation to hospital. A higher mortality rate was observed in patients who presented late to hospital (after 6 hours) and it was found to be statistically significant using chi-square test (p = 0.02).

Table 2. Clinical profile and final outcome

Clinical Presentation		
Clinical Feature	**Frequency**	**Percentage (%)**
Vomiting	88	84.6
Pain abdomen	85	81.7
Oral ulcer	34	32.7
Odynophagia	62	59.6
Shock	7	6.7
Duration of Hospital Stay (Only Survived Case)		
Substance Consumed	**Duration of Stay**	
Paraquat	10.3 ± 3.6	
Phenyl	3.4 ± 0.6	
Pyrethroid	3.1 ± 0.6	
Organochloride	3.5 ± 0.5	
Rodenticide	3.3 ± 0.4	
Hepatic and Renal Involvement in Paraquat		
	Frequency	**Percentage**
Acute Hepatitis	33	66
Acute Kidney Injury	43	86

Table 3. Final outcome of patients

Clinical Outcome		
Substance Consumed	**No. of Death**	**Percentage**
Paraquat	44	88
Phenyl	0	0
Pyrethroid	0	0
Rodenticide	2	18.2
Organochloride	2	50
Carbamate	2	100

Table 4. Correlation between mortality and time of presentation

Time of Presentation	Expired	Survived	p value
Before 6 Hours	29	42	0.02
After 6 Hours	21	12	

4. Discussion

In this present study conducted on non-organophosphorus poisoning, attempt was made to cover multiple aspects of the scenario. The incidence of poisoning was slightly higher among the males (52%) which may be due to stress and financial or family issues in the post covid era. However psychosocial analysis was beyond the scope of the study. The incidence of poisoning was quite high among the young age population and highest number of patients belonged to the age group of 20-30 years (35.6%). Other studies done by Rahmani A *et al.*, Ravichandran *et al.*, and Karthik *et al.*, also observed that majority of patients were below the age group of 40 years of age[1,16,17]. Substantial cases of paraquat, phenyl and pyrethroid poisoning were included in the study whereas the cases of carbamate and organochloride poisoning were found to be comparatively less. This is due to the easy availability and more widespread use of paraquat and pyrethroid in agriculture and phenyl in households. In this study, vomiting and pain abdomen were the most common presenting symptoms whereas oral ulceration was mainly observed in paraquat poisoning cases.

Most common alterations of biochemical profile were observed in case of renal function test and liver function test and these alterations were only associated with paraquat poisoning cases. It is expected because of the accumulation of paraquat in these organs and its primary elimination by the kidney[18]. In this study acute hepatitis and acute kidney injury was observed in 66% and 86% paraquat poisoning cases respectively. This was comparable to the study done by Rahmani *et al.*, which observed renal and liver dysfunction in 75.8% and 31.4%

patients respectively[1]. A similar study by Gao *et al.*, also observed a high incidence of acute kidney injury (71.7%)[19].

Highest number of cases presented with paraquat poisoning and mortality was also quite high (88%). Similar studies done in Indian scenario by Naik *et al.*, and Rao *et al.*, observed a mortality of 58.3% and 61% respectively[3,20]. Some other studies done in foreign countries also noted a higher mortality rate in paraquat poisoning ranging from (35-62) %[21,22]. Significant mortality was also observed in rodenticide poisoning cases (18.2%). However, other Indian studies done on rodenticide poisoning has observed a lesser mortality rate of below 10%[4,6]. This difference in mortality was probably due to lesser number of patients in our study. Early presentation to hospital was found to have association with better final outcome in this study which is mainly because of early intervention and more effective treatment. Out of the 6 patients with paraquat poisoning who survived, all of them developed acute kidney injury but only one of them had acute hepatitis. So, hepatic involvement can be a prognostic marker in these patients.

5. Conclusion

The various non-organophosphorus poisoning cases although appears to be simple but often associated with intricacies. As it was observed in our study that some of the compounds like rodenticide, paraquat and carbamate are associated with significant mortality, proper importance should be given to the patients coming with acute poisoning of these compounds. Although some studies have supported the positive role of immunosuppressants and early haemodialysis in paraquat poisoning, some other studies have shown contradictory results.

Hence development of evidence based rational management guidelines is crucial for preventing morbidity and mortality and further studies should be conducted to look for alternative treatment options for these patients.

Majority of the cases of poisoning were observed in young age population which indicates that counselling and awareness programmes are necessary targeting specifically this age group. Proper education regarding handling of these compounds should be given to people who have frequent professional exposure to these items to prevent accidental poisoning.

6. Acknowledgement

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