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A cross-sectional study of the clinical profile of children admitted with yellow phosphorous poisoning in a tertiary care hospital

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ABSTRACT

Background: Yellow phosphorous (YP) is a protoplasmic poison that is mainly used as a rodenticide. **Aims and Objectives:** The aim of the study is to describe the clinical profile of YP poisoning in children in a tertiary care hospital. **Materials and Methods**: This is a cross-sectional study done in a tertiary care hospital in Tamil Nadu. A convenience sample of all the cases admitted during the year 2022 was done. Demographic and clinical data were collected and analyzed. **Results:** The male: female ratio was 1.16:1 (n = 13). The mean age of the children was 4.0769 ± 1.373 years. About 84.61% of the children reported to the hospital within 6 h. On admission, fever (30.76%), vomiting (30.76%), abdominal pain (30.76%), bleeding (15.38%), and altered sensorium (15.38%) were the common symptoms. All the children ingested YP accidentally. Leukocytosis was observed in about 30.76%. The mean peak serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels were 516.9231 ± 685.976 IU/L and 161.9231 ± 215.107 IU/L, respectively. There were no alterations in the Electrocardiographic tracings, levels of serum electrolytes, blood glucose, and serum creatinine in children with YP poisoning. Significant differences were observed between children who survived and children who died in the levels of mean peak AST, mean peak ALT, INR, and in the presence of encephalopathy and bleeding manifestations. **Conclusion:** YP is an uncommon but lethal poison in children. Creating awareness among parents about the dangers of YP and nationwide prohibition of the sale of YP will be an important step in eliminating deaths in children who are accidental victims.

Key words: Rodenticide; Plasma exchange; Liver transplantation; N-acetyl cysteine

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INTRODUCTION

Yellow phosphorous (YP) is a protoplasmic poison that is mainly used as a rodenticide and in fireworks.[1] YP is commonly available as a 3% paste and is the largest-selling rodenticide in India.[2] YP is a common suicidal agent in adults, and it is almost always accidental in children.[3] YP is directly toxic to the liver and the lethal dose of YP is 1 mg/kg and ingestion more than that causes acute fulminant hepatic failure and death.[4] The affected children are asymptomatic for the first 3 days.[4] After 3 days they develop hepatic dysfunction, acute fulminant hepatic failure, and coagulopathy. Alterations in the central nervous system include psychosis and coma. YP poisoning is also associated with cardiac toxicity, which includes hypotension, arrhythmias, and shock. Some of the patients with YP poisoning have also developed acute tubular necrosis and/or acute renal failure.

A survey done by the Tamil Nadu chapter of the Indian Society of Gastroenterology in 2019 identified YP ingestion as the most common cause of acute hepatotoxicity, which was associated with 35% poor prognosis.[5] No specific antidote is available for YP, and the treatment is mainly supportive.[6] The only definitive treatment of fulminant hepatic failure associated with YP poisoning is liver transplantation, which is not always possible. The Tamil Nadu government in the year 2022 prohibited the sales of

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YP in the state to prevent deaths due to YP poisoning.[7] However, YP is still available in other states and online. There are many studies available that have described the clinical features of YP poisoning in adults. However, there has been a paucity of studies that have described the clinical features of YP poisoning in children.

Aims and objectives

The aim of the study is to describe the clinical profile of YP poisoning in children in a tertiary care hospital.

MATERIALS AND METHODS

This is a cross-sectional study done in a tertiary care hospital in Tamil Nadu. The inclusion criteria were to include all the children admitted with YP poisoning during the study period between January 2022 and December 2022. A convenience sample of all the cases admitted during the study period was done. The children with other rodenticide poisonings were excluded from the study. The data such as age, gender, ingestion-admission interval, presence of fever, vomiting, abdominal pain, bleeding manifestations and/or encephalopathy, and outcome were collected. Laboratory data such as white blood cell count, peak aspartate aminotransferase (AST), peak alanine aminotransferase (ALT), prothrombin time (PT) serum electrolytes, blood glucose, and serum creatinine were also collected. Electrocardiographic (ECG) findings were recorded. History of blood transfusion and/or fresh frozen plasma (FFP) administration was recorded.

The results were tabulated and analyzed. Data were analyzed statistically using the Statistical Package for the Social Studies version 26.0. All categorical data were presented using frequency and percentage and all continuous measurements were summarized using Mean±SD. The association of demographic and other clinical characteristics was compared between children who survived and children who died using the Chi-square test. P-value will be considered significant at a 5% level of significance for all analyses. Institutional human ethics committee approval was obtained. Informed consent was obtained from the parents.

RESULTS

The results are tabulated in Table 1. There were 13 children admitted during the year 2022 with YP poisoning. The male: female ratio was 1.16:1. More than three fourth of the children (76.92%) were below 5 years of age and the mean age of the children admitted with YP is 4.0769±1.373 years. About 84.61% of the children reported to the hospital within 6 h of ingestion of YP. On admission fever (30.76%), vomiting (30.76%), abdominal pain (30.76%), bleeding (15.38%), and altered sensorium (15.38%) were the common symptoms. All the children ingested YP accidentally and there were no suicidal/homicidal intentions observed.

The results of the laboratory parameters observed during the study are shown in Table 2. Leucocytosis was observed in about 30.76% of the children. All the children were serially monitored for liver functions; the mean peak serum AST and ALT levels were 516.9231±685.976 IU/L and 161.9231±215.107 IU/L, respectively. There were no alterations in the levels of serum electrolytes, blood glucose, and renal function tests in children with YP poisoning. There were also no alterations in ECG recordings in the children. All the children were treated with N-Acetyl Cysteine, vitamin K, and other supportive measures. About 38.46% of the children required blood/FFP transfusions. During the study period, 2 children died, and the admission death interval was <24 h in both cases.

There were 2 deaths observed in children with YP poisoning during the study period. The first child was a 3-year-old girl, who was brought after 70 h of ingestion of YP, with hematemesis and encephalopathy, and died on the same day. The other child was a 2-year-old girl, who was brought within 1 h of YP ingestion, developed fatal fulminant hepatic failure, and died on the same day. In the comparison of the clinical profile of the children who died and survived, both deaths were observed in girls, and

Table 1: Baseline characteristics (n=13)

Character	No (%)
Gender	
Male	7 (53.84)
Female	6 (46.16)
Age	
<5 years	10 (76.92)
6–10 years	3 (23.08)
>11 years	0
Ingestion-admission interval	
<6 h	11 (84.61)
6–12 h	1 (7.69)
13–24 h	0
>24 h	1 (7.69)
Mean interval	8.1538±9.74 h
Bleeding manifestations	
Present	2 (15.38)
Not present	11 (84.62)
Encephalopathy	
Present	2 (15.38)
Not present	11 (84.62)
Blood transfusion/Fresh frozen plasma treatment	
Given	5 (38.46)
Not given	8 (61.54)
Outcome	
Discharged	11 (84.62)
Expired	2 (15.38)

both were <5 years of age and accidentally consumed YP (Table 3). The children who died had a significantly higher incidence of bleeding manifestations and encephalopathy (P<0.001). The mean peak AST levels among the children who survived and died were 161±147.736 IU/L and 2,474.5±3,243.768 IU/L, respectively (P=0.002). The mean peak ALT levels among the children who survived and died were 66.5455±61.006 IU/L and 778.5±1,034.596 IU/L, respectively (P=0.002). The children who died had significantly elevated PT/INR more than 4 times (P=0.002). Both the children died while plasma exchange therapy (PLEX) was being arranged.

DISCUSSION

The National Poison Information Centre managed by All India Institute of Medical Sciences, New Delhi, reports a 17.06% incidence of rodenticide poisoning among all poisonings in India in all groups.[8] A robust search of the literature for YP poisoning, yields many studies in adults but not in children. In the present study, we have attempted to demonstrate the clinical profile and outcome in children. In our study, in all the children with YP poisoning, the cause was accidental and about 76.92% of children were below 5 years of age. In a few studies in India, a few instances of homicidal YP poisoning have also been reported.[9,10] In other studies, similar age group preponderance was observed.[9] Children easily mistake YP paste for toothpaste and consume it.

The common early symptoms observed were abdominal pain and vomiting in 30.76% of children in this study. Similar symptoms were observed in a study by Venugopal et al., in adults.[2] In our study, about 84.61% of the children were admitted within 6 h of ingestion of YP. The mean admission-seeking time in a study by Venugopal et al. was 6.0±6.3702 h.[2] Children with YP poisoning usually remain asymptomatic or develop mild symptoms like vomiting in the first 72 h of ingestion.[11] We observed that one child who died was admitted after 70 h of ingestion of YP. The parents should be educated about this and advised to immediately take their children with YP ingestion to a tertiary care hospital for appropriate management.

In this study, we demonstrated significant differences in mean peak AST and ALT levels in survivors and children who died. This was demonstrated in other studies also.[2,12] YP is a hepatotoxic agent, that can cause fulminant hepatic failure in some cases. Though various hepato-protective treatments such as N-Acetyl Cysteine and vitamin K are advised for milder forms of hepatotoxicity, the only definitive treatment option available for fulminant hepatic failure is emergency liver transplantation.[5] Emergency liver transplantation is not easily accessible to everyone because of resource constraints. In the present study, we did not observe changes in ECG tracings, blood glucose, serum electrolytes, and serum creatinine in children with YP poisoning. This is in contrast to studies of adults, which have documented significant changes in them.[2]

There were significant differences in PT/INR among the survivors and children who died in this study. Similar findings were made by other studies as well.[2,12] All the children were treated with NAC and vitamin K in this study. Currently, PLEX therapy is increasingly used for YP poisoning.[13,14] The indications for PLEX therapy are the presence of deranged liver function tests and any one of the following 3 criteria: INR ≥4, worsening of INR on serial monitoring, or altered level of consciousness.[5] However, the evidence for PLEX as an efficient treatment option for YP poisoning is still lacking.

Table 2: Laboratory parameters observed

Parameter	Mean±SD
WBC count	11,369.2308±2,538.426/cu.mm
Peak AST	516.9231±685.976 IU/L
Peak ALT	161.9231±215.107 IU/L
Blood glucose	118.1538±13.147 mg/dL
Serum sodium	134.3846±1.865 meq/L
Serum potassium	4.1769±0.115 meq/L
Serum creatinine	0.7923±0.0865 mg/dL
INR	3.18±1.79

WBC: White blood cell, ALT: Alanine aminotransferase

Table 3: Correlation between survived and expired children

Parameter	Survived	Expired	P-value*
Gender			
Male	7	0	0.097
Female	4	2	
Ingestion-admission interval			
<6 h	10	1	0.140
>7 h	1	1	
Bleeding manifestations			
Present	0	2	<0.001
Absent	11	0	
Encephalopathy			
Present	0	2	<0.001
Absent	11	0	
Peak AST levels (IU/L)			
<100	8	0	0.002
101–1000	3	0	
>1001	0	2	
Peak ALT levels (IU/L)			
<100	8	0	0.002
101–1000	3	0	
>1001	0	2	
Prothrombin time/INR			
Normal	6	0	0.002
Raised to 4	5	0	
Raised >4.1	0	2	

*Chi-square test, ALT: Alanine aminotransferase, AST: Aspartate aminotransferase

Limitations of the study

The limitation of this study is a small sample size, and the survivors were not followed up.

CONCLUSION

YP is an uncommon but lethal poison in children. YP remains primarily a hepatotoxic poison and alterations in renal and cardiac functions are uncommon. Early admission can be an important prognostic factor in preventing mortality. Creating awareness among parents about the dangers of YP and nationwide prohibition of the sale of YP will be an important step in eliminating deaths in children who are accidental victims.

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