



## A STUDY ON ACUTE HYDROCARBON POISONING IN PEDIATRIC AGE GROUP IN A TERTIARY CARE CENTRE

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### ABSTRACT

**Introduction:** Hydrocarbons represent a diverse group of substances and occasionally the terms “hydrocarbon” and “petroleum distillate” are used interchangeably. Ingestion of hydrocarbons is a common cause of childhood poisoning in low- and middle-income countries. In clinical practice, the term “hydrocarbon ingestion” refers to the oral intake of petroleum distillates such as motor oil, mineral oil, kerosene, gasoline, lamp oil, cigarette lighter fluid and naphtha. **Aim & Objective:** To study the factors associated with hydrocarbon ingestion and its outcome in children presenting to a tertiary care centre in age group of 1 – 14 years. **Method:** It's a hospital based direct observational study. **Observation:** The most common age of presentation was 1 to 4 years. Among hydrocarbons most commonly ingested hydrocarbon was kerosene. **Conclusion:** Acute hydrocarbon poisoning is a prevalent household accidental toxic hazard among rural male children of upper lower and lower economic classes. Symptomatic treatment is effective in management of hydrocarbon ingestion.

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### INTRODUCTION

Ingestion of hydrocarbons is a common cause of childhood poisoning in low- and middle-income countries. In clinical practice, the term “hydrocarbon ingestion” refers to the oral intake of petroleum distillates such as motor oil, mineral oil, kerosene, gasoline, lamp oil, cigarette lighter fluid and naphtha, but also to other products like toluene, turpentine, cosmetics (baby oil, hair oil, sunscreens), and cleaning solvents (wood oil and metal cleansers, spot removers)<sup>1</sup>. Based on their chemical and clinical properties there are three different category of hydrocarbon like Aliphatic Hydrocarbons Halogenated hydrocarbons & Aromatic hydrocarbons and based on viscosity there are four types of hydrocarbon like very low, low, middle & high viscosity hydrocarbon<sup>2</sup>. This is not surprising in view of the fact that hydrocarbon-based products are commonly found in home. Children have access to kerosene during winter months and charcoal lighter fluid in summer season. Often, the products are inappropriately stored in drinking glasses, water bottles or unlabeled containers, and they may be attractive and pleasant-smelling, like furniture polishes. The inflammatory reaction in the lungs depends on the degree of exposure, volatility, and viscosity of the particular Hydrocarbon<sup>3,4</sup>. Increased volatility, low viscosity, and decreased surface tension of the ingested hydrocarbon are related to increased risk of aspiration and lung injury because of easy penetration of the hydrocarbon into the bronchial tree and its spread over the respiratory mucosal membrane<sup>1</sup>.

Most accidents related to spilling or ingestion of such chemicals occur in homes (75-99%), therefore being preventable<sup>5</sup>. The morbidity and mortality of hydrocarbon ingestion are mainly due to pulmonary aspiration<sup>6</sup>. Pulmonary damage is probably due to chemical destruction of surfactant in alveoli and distal airways. The hydrocarbon also increases permeability of the vascular endothelium with subsequent diffuse hemorrhagic alveolitis culminating in a chemical pneumonitis<sup>7</sup>. Cardio toxicity generally manifests as dysrhythmias, secondary to hydrocarbon sensitization of myocardium to the circulating catecholamines<sup>8</sup>.

Systemic manifestations often include confusion, ataxia, lethargy and coma. Ingestion often causes abrupt nausea and vomiting<sup>10</sup>. No specific antidotes are available for hydrocarbon poisoning; therefore treatment is usually symptomatic and supportive. Gut decontamination remains a controversial area, but it is indicated in large volume (>30ml) ingestions or in hydrocarbons with inherent systemic toxicity. Severe lung injury may require intubation and mechanical ventilation<sup>10,11</sup>.

Kerosene is still extensively used for cooking, heating and lighting in the developing world and so cases of accidental poisoning by children are still relatively common in developing countries like India, other South – East Asian countries, African countries<sup>12</sup>.

Accidental ingestion of hydrocarbons in middle and low income countries are 50 times more common than high income countries because in low and middle income regions hydrocarbons are the extensively used for cooking, lighting and heating<sup>13</sup>. Young children are at high risk for accidental

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ingestion because of their immature metabolic and respiratory system. They are more likely to ingest because of their undeveloped sense of smell and taste. They mistake hydrocarbons for water or soft drinks believing it as a pleasant drink with which they are familiar<sup>14,15</sup>.

The aim of this study is to observe the Factors associated with hydrocarbon ingestion and its outcome in children presenting to S.C.B.M.C.H and S.V.P.P.G.I.P to establish evidence based measures to control and manage these preventable exposures.

**Aim of the Study:** To study the factors associated with hydrocarbon ingestion and its outcome in children presenting to a tertiary care centre in age group of 1 – 14 years.

**OBJECTIVES**

To investigate 1) The types of hydrocarbon ingested by the children. 2) Socio – demographic characteristics of hydrocarbon ingestion. 3) Time of admission and presentation pattern of hydrocarbon poisoning.

**MATERIAL**

“A study on acute hydrocarbon poisoning in paediatric age group in a tertiary care centre” was undertaken in the indoor wards of the Department of Paediatrics, S.C.B. Medical College & SVPPGIP, Cuttack. Data was collected and Investigations required were done in S.C.B Medical College and S.V.P.P.G.I.P, Cuttack during the period from December, 2017 to December, 2019. The selection of the cases and the procedures adopted in this work are detailed below.

**Study Design:** Hospital based observational study.

**Sample Size:** 110 cases

**Selection of Subjects:** All pediatrics patients admitted to indoor wards of Department of pediatrics in age group of 1 to 14 yrs at S.C.B. Medical College & SVPPGIP, Cuttack, full-filling the inclusion criteria were examined, investigated and necessary data was noted in a pre-designed proforma. The criteria for case selection in the present study were:

**Inclusion Criteria :** All indoor patients admitted to the Dept of pediatrics after ingestion of hydrocarbons from age 1 – 14yrs.

**Exclusion Criteria:** 1. Accidental ingestion of other substances along with hydrocarbons. 2. Children who are having disorders of developmental delay such as cerebral palsy, neurodegenerative diseases. 3. Patients who left against medical advice prior to detailed evaluation

**Study Period:** 2 years (December 2017 to December 2019)

**METHODOLOGY**

After acquiring the required approval from the Ethical committee, we began data collection at the fore mentioned place, of patients fulfilling the criteria and giving written consent as per predesigned proforma.

**Investigations Included:** 1. Chest X-Ray. 2.Routine examination of blood like Complete Blood Counts, RFT, LFT whenever required. **Statistics:** Simple statistics involving mean with range was used along with graphs and charts which were obtained via Microsoft excel data assessment. Microsoft word was used to prepare the study and incorporate the various charts and data. No special software was used for the study.

**Observation**

A total number of 110 cases were included in the study that fulfilled inclusion and exclusion criteria. The following observation and results are obtained.

**Table 1** Age & Sex wise incidence

Age in years	Male	Female	Total
Less than 2yr	20	12	32
2yr to 4yr	34	22	56
More than 4yr	14	8	22
Total	68	42	110

Among male children 29% were less than 2yrs, 50% were 2 to 4 yrs and 21% were more than 4yrs of male population. Among female children 29% were less than 2yr, 52% were 2 to 4 yrs and 19% were more than 4yr of female population.

**Table 2** Hydrocarbon Poisoning by Months

Months	Number of cases	Percentage
January to April	22	20%
May to August	64	58.2%
September to October	24	21.8%
Total	110	100%

The study was done from December 2017 to December 2019. Total of 110 patients were included in the study. To assess the hydrocarbon ingestion by months we have taken occurrence from January to April, May to August and September to December. According to the above, 22 cases (20%) occurred from January to April, 64 cases(58.2%) occurred from May to August, 24 cases(21.8%) occurred from September to December.

**Table 3** Distribution of Residence, Parent’s Education & Socioeconomic Status

Criteria	Residence		Parents education		Social economic status				
	Urban	Rural	Literate	Illiterate	Lower	Upper lower	Middle	Upper	
Number	32	78	82	28	26	50	16	10	8
Percentage	29.1	70.9	74.5	25.5	23.63	45.46	14.54	9.1	7.27

Out of total 110 cases, 32 (29.1%) were from urban areas and 78 (70.9%) were from rural areas. Parent’s education was taken by the definition of literacy, that is who can read and write with understanding. Among 110 cases, parents of 82 cases (74.5%) were literate and 28 cases (25.5%) were illiterate.

The socio-economic class of all patients was noted as per modified Kuppuswamy classification. Of 110 cases, 50(45.46%) cases were from upper lower class, 26 (23.63%) cases were from lower class. There were 16 (14.54%) cases from lower middle class, 10(9.1%) cases from upper middle class and 8(7.27%) cases from upper class.

**Table 4** Type of Hydrocarbon Ingested

Types of hydrocarbon	Number of subjects	Percentage
Kerosene	84	76.4%
Turpentine	22	20%
Petrol	2	1.8%
Diesel	2	1.8%
Total	110	100%

Among 110 cases, 84 cases (76.4%) ingested kerosene, 22 cases (20%) ingested turpentine, 2 cases (1.8%) ingested petrol and 2 cases (1.8%) ingested diesel.

**Table 5** Storage Container

Container	Number of cases	Percentage
Water bottle	22	20%
Soft drink bottle	88	80%
Total	110	100%

The kerosene was stored in water bottles in 22 cases (20%) and in soft drink bottles in 88 cases (80%). In all cases the containers were placed at reachable places like on the floor or in the lower shelves of open cup-board.

**Table 6** Manner of ingestion

Manner of ingestion	Number of cases	Percentage
Accidental	108	98%
Suicidal	2	2%
Total	110	100%

Among 110 cases, 108 cases (98%) were accidental ingestion of hydrocarbons and 2 cases (2%) were with suicidal intention.

**Table 7** Time Interval Between Ingestion Of Hydrocarbon And Hospitalization

Time interval	Number of cases	Percentage
Less than 6 hours	64	58.1%
6hours to 12 hours	40	36.4%
More than 12 hours	6	5.5%
Total	110	100%

Of 110 cases, 64 cases(58.1%) were admitted in less than 6 hours from ingestion, 40 (36.4%) cases were admitted between 6 to 12 hours, 6 (5.5%) cases were admitted after 12 hours of hydrocarbon ingestion.

**Table 8** Clinical signs and symptoms

Clinical signs and symptoms	Number of cases	Percentage
No symptoms and signs	34	30.9%
Fever	66	60%
Cough	76	69.1%
Vomiting	42	38.1%
Tachypnea	50	45.4%
Respiratory distress	28	25.4%
CNS manifestations	18	16.3%

Among 110 cases, 34 cases (30.9%) had no signs and symptoms,66 cases (60%) had fever, 76 cases (69.1%) had cough, 42 cases (38.1%) had vomiting,50 cases (45.4%) had tachypnea, 28 cases (25.4%) had respiratory distress , 18 cases (16.3%) had CNS manifestations during admission.

**Table 9** Treatment received

Treatment received	Number of cases	Percentage
Oxygen	28	25.4%
Anti-pyretics	66	60%
Antibiotics	62	56.3%
Steroids	52	47.2%
Mechanical ventilation	3	2.72%

Among 110 cases, 28 cases (25.4%) required oxygen, 66 cases (60%) received anti-pyretics, 62 cases (56.3%) received antibiotics, 52 cases (47.2%) received steroids, 3cases (2.72%) required mechanical ventilation.

**Table 10** Number of days of hospitalization

Number of days of hospitalisation	Number of cases	Percentage
Less than 3 days	38	34.5%
3 days to 7 days	56	51%
More than 7 days	16	14.5%
Total	110	100%

Among 110 cases, 38 cases (34.5%) were hospitalized for less than 3 days, 56 cases (51%) were hospitalized for 3 to 7 days, 16 cases (14.5%) were hospitalized for more than 7 days.

Mean duration of hospitalization was 4.4 days with standard deviation of 3.1.

**Outcome:** All the 110 subjects were discharged after observation and treatment. There were no deaths.

## DISCUSSION

Hydrocarbon ingestion is common in children in developing countries like India. We here conducted the study, to study the factors associated with hydrocarbon poisoning and its outcome in the pediatric age group. The results varied with what we would expect and also gave us some insight into the problem. Based on the study the following inferences were obtained.

### Age & Sex Distribution

The hydrocarbon poisoning occurred mostly in young children with range of one year to 12 years with a mean age of 3.2. 80% of the children in the study were below 4 years.

Jayashree *et al* in their study conducted at Chandigarh found that 95% of hydrocarbon poisoning occurred in children below 5 year<sup>16</sup>.

In a study conducted at Benha University, Egypt, 76.4% of hydrocarbon poisoning cases were in patients less than 5years<sup>17</sup>.

As discussed earlier the reason for this may be the immature development of olfactory functions in young children. They tend to get attracted easily by the color and smell of hydrocarbons. In all cases the kerosene was stored in water bottles or soft drink bottles and kept at reachable places at home, particularly in kitchen.

Among 110 cases, 62% cases of hydrocarbon poisoning were boys. Male: Female ratio is 1.6:1.

The results are in agreement with Lucas *et al*<sup>18</sup> who showed that males constituted 62.5% of kerosene poisoning patients and females constituted 37.5%.

In a study by Lifshitz *et al* on hydrocarbon poisoning males was 61% and females were 39%<sup>12</sup>.

On comparing age Vs sex distribution poisoning occurred at highest in boys in 2 to 4 years age group. In all age groups boys are commonly affected. The reason behind male preponderance may be the higher degree of hyperactivity behavior among boys<sup>19</sup>.

### Hydrocarbon Poisoning by Months

The poisoning occurred in 58.2% of cases in summer months of may to august as children get thirsty often and tend to drink the hydrocarbons stored thinking it to be water or soft drinks because of the container used<sup>20</sup>.

Tagwireyi *et al* in their study of hydrocarbon poisoning in Zimbabwe, reported that there was no major notable seasonal variation, as there were peaks in admissions in months of January, April and August<sup>21</sup>.

These results are in agreement with those achieved by Lifshitz *et al* on hydrocarbon poisoning who found that there is significantly higher prevalence of hydrocarbon poisoning in summer 39%<sup>12</sup>.

### Residence, Parents Education & Socioeconomic Status Of Parents

Among 110 cases, 70.9% of children admitted with hydrocarbon poisoning were from rural areas as the kerosene usage is more common in rural area compared to urban population. Kerosene is also used for initiation of fire while cooking with woods in rural areas.

Shotar *et al* found that 94% of the kerosene poisoned patients who were hospitalized in Princess Rahmat hospital, northern Jordan live in rural areas<sup>22</sup>. Literacy rate of Odisha according to 2011 census is 72.87%. In our study 74.5% of parents were literate.

The study is conducted in a tertiary care centre at a Government hospital, it is expected that the load of lower socio-economic group will be higher. In our study, 69.09% cases were from lower and upper lower class. There were 14.54% cases from lower middle, 9.1% from upper middle and 7.27% cases from upper class .

Morbiwala *et al*<sup>23</sup> in their study concluded that 83% of the poisoning occurred in lower class and 17% occurred in middle class families children. In a study conducted in Bangladesh on kerosene poisoning 91% cases occurred in lower class and 9% cases occurred in middle class families children<sup>24</sup>.

### **Type of Hydrocarbon Ingested**

In this study 76.4% of the cases ingested kerosene, 20% of cases ingested turpentine oil, 1.8% cases ingested petrol and 1.8% ingested diesel.

Jayashree *et al* in their study concluded that of the hydrocarbons ingested, kerosene was the commonest 41 (85%), followed by petrol 3 (6%), turpentine oil 2 (4%) and diesel and sewing machine lubricant in one patient each<sup>16</sup>. In a study by Lifshitz *et al* 96% of the patients were poisoned by kerosene; of the remaining 4% ingested gasoline, acetone, turpentine, or thinner<sup>12</sup>.

### **Storage of Hydrocarbon**

Among 110 cases, hydrocarbons were used for cooking purpose in 76 cases (69.1%), heating and other purposes at home in the 34 cases (30.9%). Though there were facilities of electricity and LPG, kerosene was used in the families for cooking and other purposes due to easy availability and subsidized price.

The kerosene was stored in water bottles in 22 cases (20%) and in soft drink bottles in 88 cases (80%). Mickiewikz and Gomez<sup>10</sup>, Abu Ekteish<sup>25</sup> stated that many household hydrocarbons attract toddlers as they may be stored in familiar bottles, a relatively common household practice – increasing the inadvertent ingestion by mistaken identity. Shotar *et al* found in their study that in 52.3% of the kerosene ingested patients, it was stored in non-original containers (familiar household containers like water jugs and soft drink bottles)<sup>22</sup>.

### **Manner of Ingestion**

In our study among 110 cases, ingestion in 108 subjects was accidental and 2 subjects were suicidal. ickiewikz and Gomez<sup>10</sup> stated that most of hydrocarbon exposures i.e. 95% result from accidental ingestion, but significant intentional abuse of these substances exists in the United States and abroad at likely under recognized levels. Pande *et al*<sup>26</sup> and Bray *et al*<sup>27</sup> stated that the use of hydrocarbons for suicidal and homicidal purposes is quite infrequent with the increased availability of pesticides and other toxic substances.

### **Time Interval Between Ingestion of Hydrocarbon And Hospitalisation**

Of 110 cases, 64 cases (58.1%) were admitted in less than 6 hours from ingestion, 40 (36.4%) cases were admitted between 6 to 12 hours, 6 (5.5%) cases were admitted after 12 hours of hydrocarbon ingestion .

### **Clinical Symptoms and Signs at the Time of Admission**

Among 110 cases, 34 cases (30.9%) had no signs and symptoms, 66 cases (60%) had fever, 76 cases (69.1%) had cough, 42 cases (38.1%) had vomiting, 50 cases (45.4%) had tachypnea, 28 cases (25.4%) had respiratory distress, 18 cases (16.3%) had CNS manifestations during admission .

In a study by Lifshitz *et al*<sup>12</sup> fever was present in 63.5%, cough in 38%, vomiting in 51%, tachypnea in 73.7%, respiratory distress in 27.1%, CNS manifestations in 31.4%. In a study by Nagi NA and Abdullah ZA<sup>28</sup> fever was present in 73.8%, cough in 83.5%, vomiting in 60.2%, tachypnea in 51.5%, respiratory distress in 10%, CNS manifestations in 63.1%.

### **Treatment Received**

Among 110 cases 28 cases required oxygen, 66 cases received anti-pyretic, 62 cases received antibiotics, 52 cases received steroids, 3 cases required mechanical ventilation.

Thalhammer *et al*<sup>6</sup> in their study of hydrocarbon poisoned patients concluded that the use of antibiotics and steroids in hydrocarbon poisoning appeared justified in patients who have pre existing respiratory illness or who develop complications. Sibal Das *et al*<sup>29</sup> in their study in JIPMER concluded that if there are preexisting risk factors or pneumonitis and/or established secondary infections, steroids and antibiotics could be used therapeutically.

### **Number of Days of Hospitalisation**

Among 110 cases 38 cases (34.5%) were hospitalized for less than 3 days, 56 cases (51%) were hospitalized for 3 to 7 days, 16 cases (14.5%) were hospitalized for more than 7 days.

### **Outcome**

All the 110 subjects were discharged after observation and treatment. There were no deaths.

### **Summary**

The most common age of presentation was 1 to 4 years. The mean age of presentation was 3.2 years. Male preponderance was found in the study. Male to female ratio was 1.6:1. Among 110 cases, 64 cases (58.2%) cases occurred from May to August. Patients who reside in rural areas were 70.9%. In this study 74.5% of parents were literate. Most of the population belonged to the Lower socio-economic class as per modified Kuppuswamy classification. Among hydrocarbons most commonly ingested hydrocarbon was kerosene 76.4%. Hydrocarbons were stored in water bottles and soft drink bottles for cooking and heating and other purposes. Most of the patients consumed hydrocarbons accidentally 98%. Route of poisoning in all the 110 subjects was by oral ingestion. Of 110 cases, 64 cases were admitted to hospital in less than 6 hours from the time of ingestion of hydrocarbons. Most common presentation at time of hospitalization was cough, fever, tachypnea. 84 cases were managed in wards and 16

cases required ICU. Chest X-Ray done after 6 to 8 hours of ingestion of hydrocarbon was abnormal in 54.5% of cases. Among 110 cases 66 cases (60%) received anti-pyretic, 62 cases (56.3%) received antibiotics, 52 cases (47.2%) received steroids, 25.4% required oxygen, 3 cases (2.72%) required mechanical ventilation. Most children 51% required hospitalization for 3 to 7 days, All the 110 subjects were discharged after observation and treatment without any mortality and morbidity.

## CONCLUSION

Acute hydrocarbon poisoning is a prevalent household accidental toxic hazard among rural male children of upper lower and lower economic classes under age of 4 years, and during the hot months of the year. Patients must be monitored both by clinical and radiological examination to recognize potential pulmonary complications. There is no specific treatment. Symptomatic treatment is effective. Preventive measures need to be adopted to spread awareness among parents about this toxic hazard. Child resistant packages for products that contain low viscosity hydrocarbons are warranted, to protect children from serious injury associated with hydrocarbon aspiration.

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