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Care Pathways

Hydrocarbon Poisoning

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ABSTRACT

Hydrocarbon poisoning is a common cause of accidental poisoning in children. The most important complication anticipated with hydrocarbon ingestion is chemical pneumonitis. Monitoring and supportive care is the key to successful management of hydrocarbon poisoning as prognosis is good in such cases. Long term complications in the form of abnormal pulmonary function tests may be observed in few cases.

Key words: hydrocarbon, poisoning, children

CASE VIGNETTE

A 3-year old boy is brought to the emergency department (ED) with sudden onset of fever, lethargy, cough, and chest in-drawing. He was normal till 3 hours back when his mother noticed him sipping from a bottle containing kerosene. On examination, he was lethargic, cyanosed, tachypneic with nasal flaring and retractions. His saturation was 85% and auscultation of the chest revealed rales and rhonchi.

As the attending emergency physician in the ED we are confronted with the following questions:

1. Should gastric lavage be done to empty his stomach contents, given the history of accidental ingestion?
2. What supportive care should be started now? Till when should he be observed?
3. Should a chest X-ray be ordered for him?
4. Do we need to start antibiotics in this child?
5. Is there a role of steroids in this condition?

The following article is an attempt to answer the above queries we are often faced with in the emergency department on a day to day basis in a case of hydrocarbon poisoning.

INTRODUCTION

Hydrocarbon ingestion is a common cause of accidental poisoning in children. Worldwide 5% of all accidental poisonings and about 25% of all deaths in children <5 years are related to hydrocarbon (HC) ingestion.[1,2] Children are often accidental victims of HC poisoning as these products are inappropriately stored in unlabeled containers or water bottles and are often attractive in color.

The hydrocarbons are a diverse group of substances that have been broadly classified into two types based on their clinical effects:[3]

1) *HC with predominantly aspiration potential*: kerosene, gasoline, naphtha, and mineral seal oil and
2) *HC with systemic toxicity in addition to their aspiration potential*: trichloroethane, methyl chloride, benzene, toluene, xylene.

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PATHOPHYSIOLOGY

The toxicity of hydrocarbons is due to their low surface tension and vapor pressure which helps them spread over large surface area of the lungs and cause chemical pneumonitis. While lower surface tension helps in spreading over a large area, lower viscosity enhances penetration into distal airways leading to severe necrotizing pneumonia.[4] Thus compounds like kerosene, gasoline and naphtha with high volatility, low viscosity, and low surface tension are more likely to be aspirated and cause severe lung injury.

It is usually difficult to estimate the exact amount of hydrocarbon ingested by a child as some of it is spilled while drinking and parents are often unaware of the actual amount stored in the container. The ingested amount could vary anywhere between 30 to 90 ml.[5]

The effects of hydrocarbon poisoning on different systems are described below:

Respiratory system: The necrotizing pneumonia that ensues following hydrocarbon poisoning is due to aspiration and not GI absorption.[5,6] Ingestion of small amounts also may lead to aspiration because most children vomit after ingestion and this leads to aspiration. However, not all cases of aspiration are preceded by vomiting.[3] The mere presence of hydrocarbon in the hypopharynx has been found to cause chemical pneumonitis by spreading to contiguous surfaces in the airway.[7]

Central nervous system: CNS injury is seen in cases of poisoning with volatile hydrocarbons which reach the CNS through the bloodstream after ingestion or inhalation. CNS manifestations are more often due to hypoxia and acidosis from damage to the lungs than due to systemic absorption.[8]

Gastro intestinal system: These compounds are known to cause gastric irritation leading to erosion. Animal experiments have also revealed fatty infiltration of liver.[3]

CLINICAL FEATURES

The hydrocarbons commonly ingested in accidental poisonings have low systemic toxicity and more local effects.[7] The two systems commonly affected by hydrocarbon ingestion are lungs and CNS.[4] The common clinical features of hydrocarbon ingestion are given in the table below (Table 1).

Table 1: Clinical features of hydrocarbon poisoning

System affected	Clinical features
1. Respiratory system	*Coughing, choking, cyanosis, tachypnea, nasal flaring, retractions and occasionally hemoptysis; on auscultation rhonchi and rales may be found.*
2. Central nervous system	*Restlessness, drowsiness, lightheadedness, dizziness, euphoria, headache, visual disturbances, impaired memory. In few cases respiratory paralysis, convulsions, and coma may develop.*
3. *Gastro intestinal system*	*Nausea, vomiting, pain abdomen, diarrhea, constipation, and malena.*
4. Other systems	*Cardiac dysrhythmias, peripheral neuropathy, dyselectrolytemia,*

Pulmonary effects may develop within 6 hours or may be delayed for up to 48 hrs.[3, 4, 5] Vomiting - whether spontaneous or induced - increases the chances of aspiration and chemical pneumonitis.[3, 4] Following aspiration, coughing, choking and signs of respiratory distress develop which may worsen over the next 24-48 hours. Direct aspiration into trachea (even as small a quantity as 1 ml) can cause pneumonitis and death. Recovery usually takes about a week but may be prolonged if superadded pneumonia develops.

Fever may develop within 30 minutes in some children which may persist for several days. The severity and duration of fever usually correlates with the extent of lung involvement.[3]

Cardiac dysrhythmias are commonly seen with abuse of cyclic/aromatic group of hydrocarbons like toluene, xylene and benzene. They occur due to sensitization of the heart to catecholamines. Chronic exposure to hydrocarbons may cause peripheral neuropathies, electrolyte abnormalities and nephrotoxicity.[3]

The common manifestations of HC poisoning in children as reported by a study from India are respiratory distress (100%), altered sensorium (46%), vomiting (13%), fever (8%) and seizures (4%).[9]

MANAGEMENT

Investigations

CXR: A chest X-ray is indicated in all cases of hydrocarbon ingestion irrespective of their symptomatology as it is not unusual to find radiographic abnormalities in completely asymptomatic children or in whom no abnormalities are found on clinical examination. The CXR abnormalities commonly found include fine, punctuate, mottled densities in the perihilar areas and midlung fields. Other abnormalities found include localized areas of atelectasis, consolidation, pleural effusion, empyema, pneumatocele, pneumothorax, pneumomediastinum and subcutaneous emphysema. Radiographic abnormalities may persist for days to weeks after resolution of clinical symptoms.[3]

Arterial blood gas: Arterial blood gas may reveal hypoxia, hypercarbia, and metabolic acidosis.

Hematologic abnormalities: Complete blood count may reveal leucocytosis. Hemolytic anemia may be an unusual finding in some patients.[3, 4]

Treatment

Treatment is mainly supportive and symptomatic. It includes close monitoring of the child, supportive care, and monitoring for complications and managing them appropriately.

Evacuation of stomach by gastric lavage or induction of emesis is not recommended because of the increased risk of aspiration following these procedures.[9, 10] However, in cases of poisoning by products contaminated by pesticides, heavy metals or other toxins, evacuation of gastric contents is recommended. While syrup of ipecac is preferred in alert children, intubation with cuffed endotracheal tube followed by lavage is recommended in an unconscious child.[3, 11]

All children with history of hydrocarbon ingestion should be observed for at least 6 hours irrespective of their clinical status; a CXR should be ordered in all children as discussed above. If they become symptomatic during this period, they should be admitted. Children with no clinical manifestations but having radiographic abnormalities should be admitted unless a close follow-up can be ensured.[3, 7] A protocol for management of children presenting to the emergency department with history of hydrocarbon ingestion is suggested below (see figure 1).

All symptomatic children irrespective of X-ray abnormality should be admitted and started on supportive therapy including oxygen, IV fluids, beta-2 agonists and positive pressure ventilation as required. Monitoring is central to the management of children with hydrocarbon ingestion and all children irrespective of their clinical status should be closely monitored. Children who are

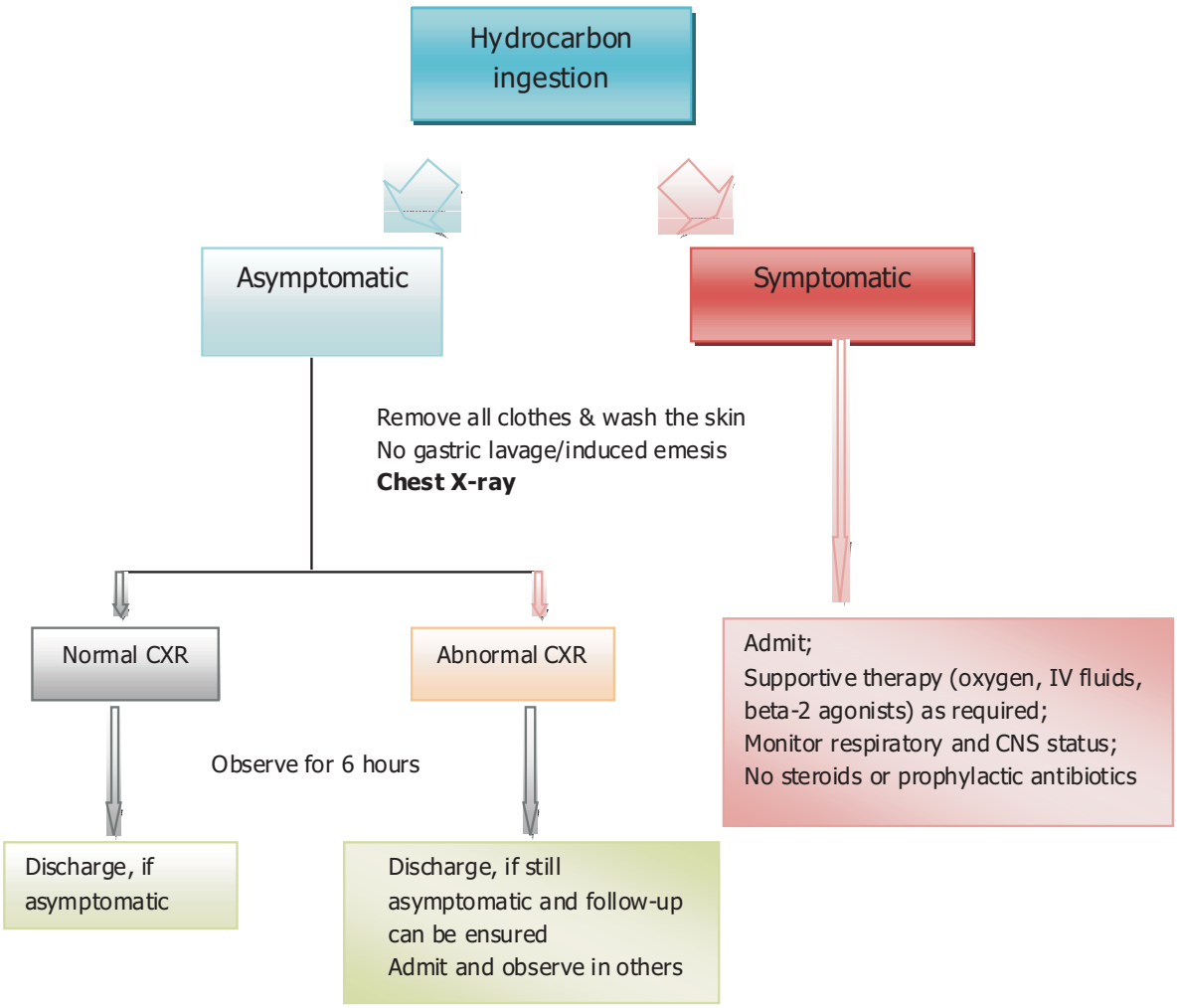
discharged and advised a close follow up should be monitored closely at home. Parents should be advised to bring the child to the emergency department in case of any danger sign explained at the time of discharge.

Steroids have been found to be ineffective in cases of hydrocarbon poisoning and hence not recommended. There is no role of prophylactic antibiotics in children with hydrocarbon poisoning unless they develop superadded pneumonia.[3]

Prognosis

Prognosis is usually good in children with hydrocarbon poisoning.[9,12] Most children have complete resolution of radiological findings as well. Long-term abnormalities like abnormal pulmonary function tests may be noted in few children; however the clinical significance of these abnormalities is unknown at present.[13]

Figure 1: Management of hydrocarbon poisoning[14]



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