Chemical and environmental toxins

Hydrocarbons
The hydrocarbon poisons are mixtures of aliphatic and aromatic hydrocarbons that vary in their molecular weight, chemical and physical properties. Hydrocarbon products represent a diverse group of substances e.g. gasoline, kerosene, mineral spirits, petroleum naphtha, petroleum ether, mineral seal oil, coal tar, benzene, toluene, xylene, turpentine.
Not all hydrocarbon-based products are sources of toxicity and not all ingested products cause toxicological problems. For example, highly viscous substances (paint, glues, asphalt, rubber) causes little hazard of aspiration. Obstruction would be the greatest concern following the ingestion of one of these highly viscous products.
On the other hand, compounds such as gasoline, kerosene, and lighter fluid contain a high percentage of aromatic hydrocarbons. These solutions have a low viscosity and low surface tension, and can spread over mucosal surfaces easily and rapidly. Consequently, their risk for aspiration is greatest.

Mechanism of toxicity
The two most common routes of exposure for hydrocarbons are inhalation and ingestion. Ingestion is the more common route of exposure encountered in acute accidental hydrocarbon poisonings. When ingested, hydrocarbons produce their toxic effects on several organ systems including the lung, CNS, gastrointestinal tract, liver, and heart. Among these, the greatest involvement occurs with the pulmonary system, and aspiration pneumonitis is the greatest cause of morbidity and mortality.
CNS involvement following hydrocarbon ingestion is not due to a direct effect on the CNS but occurs secondary to hypoxic cerebral damage resulting from the chemical-induced pneumonitis.
Studies have shown that hydrocarbons are absorbed from the gastrointestinal tract in very small quantities and the amount absorbed is not sufficient to be directly responsible for the CNS toxicity.
The most serious and potentially lethal complication of hydrocarbon ingestion is the development of a chemical pneumonitis which is related to aspiration of the poison that occurs either during ingestion or vomiting and not by circulating via the blood.
The physiochemical properties of hydrocarbons are also important factors for the increased incidence of aspiration, the risk of aspiration and lung damage is directly proportional to volatility, and indirectly related to viscosity. That is, hydrocarbons that are most likely to be aspirated are highly volatile and have a low viscosity. Hydrocarbons are also gastric irritants, and spontaneous vomiting sometimes occurs during which there is a greater chance for entry into the trachea.
Signs and symptoms

Blood
Aplastic anemia, leukopenia, thrombocytopenia, hemolysis, leukemia

Gastrointestinal
Burning and stinging in mouth, throat, esophagus, and stomach
Gagging, nausea and vomiting, diarrhea, bloody vomiting and stool.
Frequently have odor of substance (e.g. gasoline) on breath

Heart
Ventricular tachycardia and fibrillation

Hepatic
Hepatocellular necrosis, hepatomegaly, fatty degeneration

Metabolic
Metabolic acidosis

Neurologic
Euphoria, stupor, agitation, delirium, coma, slurred speech, hallucinations, blurred vision, ataxia, tremor

Renal
Tubular acidosis, acute tubular necrosis

Respiratory
Cough (may be bloody), shortness of breath, dyspnea, pneumonitis, pulmonary edema, hemorrhagic conditions

Skin
Irritation, blistering, transient cyanosis

The most clinically significant complications are CNS depression and chemical-induced pneumonitis.
Treatment

- Try to identify the ingested hydrocarbon

- The patient must be examined as soon as possible and consideration must be given to the degree of respiratory distress, extent of CNS symptoms, and radiographic evidence of hydrocarbon-induced pneumonitis before specific treatment can be suggested.

- Emesis induced by ipecac syrup is indicated for hydrocarbon ingestions containing any quantity of aromatic hydrocarbons, halogenated hydrocarbons, heavy metals or when the amount ingested exceeds 1 ml/kg.

- Emesis is not indicated in patients who have spontaneously vomited, persons without a gag reflex, comatose or convulsing patient, or have ingested a non-volatile hydrocarbon (e.g. lubricating oil, mineral seal oil).

- Various oils (of mineral and vegetable sources) have been used to increase the viscosity of ingested hydrocarbons, and thus decrease the absorption as well as reduce the chance for aspiration during the act of vomiting. Oils also act as demulcents and cathartics and, therefore, should be beneficial.

- Activated charcoal is not indicated.

- Symptomatic and supportive treatment, this include oxygen and fluid supply, controlling fever by antipyretics.
Household products toxicity

Soaps and Detergents
Soap is a salt of a fatty acid that usually results from reacting a natural fat or oil with a strong alkali, such as sodium or potassium hydroxide. A detergent, is technically any cleaning agent, they are usually based on non-soap surfactants. Most soaps are relatively nontoxic and possess an emetic action that is possibly as effective as syrup of ipecac. Soap-induced emesis is mediated through a direct effect on the gastrointestinal tract, rather than through systemic action. Ingestion of many soap products is not especially dangerous because the product is self-eliminating, and few symptoms, other than gastric upset, will be experienced. Ingestion of a strong detergent product will cause a variety of reactions, depending on the specific product, this is because detergents contain a wider variety of ingredients than soap products, most detergents consist of mixtures of inorganic and organic substances, anionic or cationic surfactants, whitening agents, fabric softeners and builders (e.g. carbonate, silicate, sulfate). The major problem from ingestion of detergent products is the builder, because of their high alkalinity, they may induce severe GI damage.

Treatment
- electrolyte replacement therapy is indicated for severe vomiting or diarrhea.
- demulcent (an agent that forms a soothing, protective film when administered onto a mucous membrane surface. For example, mucilage and oils) is indicated for mild nausea.

Bleach
Most bleach products are solutions of 3-6% sodium hypochlorite in water. The pH is approximately 11 which makes them highly alkaline. Symptoms of ingestion of bleach include severe irritation and corrosion of mucous membranes with pain and vomiting. There may be a fall in blood pressure with delirium and coma.
Treatment of bleach intoxication includes demulcent therapy. Although the pH of a bleach solution is alkaline, acidic antidotes should not be given. The reason for this is that hypochlorus acid is formed in the stomach when sodium hypochlorite reacts with hydrochloric acid. Hypochlorus acid is not toxic when absorbed in small quantities, since it is buffered by the blood. However, it is extremely irritating to both the mucous membranes of the esophagus and the gastrointestinal tract.
Bleach should never be mixed with strongly acidic or alkaline cleaning agents, because chlorine gas or chloramine gas may be released. Although inhalation of small quantities of either of these gases does not produce severe toxicity, but can cause lacrimation, and irritation of the mucous membranes. In a high concentration, both could cause asphyxiation.
Motheball

Most products that are used as mothballs contain naphthalene or paradichlorobenzene. Today, naphthalene is used less often than previously because of its great potential for toxicity. It has been replaced with the less toxic substance, paradichlorobenzene, which if ingested, may induce local irritation of the gastrointestinal tract. However, it requires no antidotal therapy, except for a demulcent, and treatment of nausea and vomiting.

Naphthalene is a powerful toxic substance that requires immediate medical treatment if ingestion occurs. At special risk are those persons with erythrocytic glucose-6-phosphate dehydrogenase (G6PD) deficiency. When they ingest naphthalene then erythrocyte membrane will break down which will lead to hemolysis. Treatment is symptomatic and supportive care.

Nail polish remover (acetone)

Acetone forms the basis for most commercial fingernail polish remover products. Acetone may be readily recognized by its sweet, sharp odor. Intoxication by acetone is a potential health hazard in industry where it is used as a solvent for a variety of lipids. Most industrial poisonings are by inhalation, with irritation of the eye, nose, and throat produced at exposures of 500 - 1000 ppm. Higher concentrations cause CNS depression.

In the home, acetone poisoning is less frequent, but it does occur. Ingestion of small quantities ranging from 10 to 20 ml does not normally produce symptoms, while 200 ml has caused severe coma in an adult. Acetone is absorbed through the skin, but the quantity that may be absorbed from nail polish removers has no medical problems. Acetone has a drying effect on the skin as it dissolves dermal lipids. Ingestion of toxic amounts of acetone induces a variety of signs and symptoms.

Nausea, vomiting, gastric hemorrhage.

CNS sedation, respiratory depression, ataxia, and paresthesias.

Coughing, bronchial irritation.

Depression may proceed to coma.

Hyperglycemia and ketonemia.

Renal tubular necrosis may occur.

Treatment

- Symptomatic and supportive care.
- Unless the patient is comatose, emesis should be performed, followed by activated charcoal and saline catharsis.
- Diazepam to control seizures.
**Disinfectants and Antiseptics**

**Phenol (Carbolic Acid)**

Phenol was one of the oldest disinfectants/deodorizers and is still used alone, as well as an ingredient in many commercial products.

Intoxication can occur following absorption of phenolic substances through intact skin, or by ingestion. Preparations containing phenol that are intended for topical use should never contain a concentration greater than 1%.

Phenol has a strongly characteristic odor and its presence can be readily detected on the breath. Phenol is a protein precipitant which induces strong corrosive actions. It is a cellular depressant and causes a variety of signs and symptoms:

- Nausea, vomiting, bloody diarrhea, abdominal cramping
- Sweating, Cyanosis
- CNS stimulation, hyperactivity, convulsions, followed by CNS depression
- Hypotension
- Increased respirations followed by depressed respirations
- Pulmonary edema, pneumonia
- Esophageal stricture
- Hemolysis, methemoglobinemia
- Jaundice
- Renal failure
- Cardiovascular collapse, shock
- Skin: erythema, corrosion

Death immediately following poisoning usually occurs from respiratory depression. Survival for a day or two after poisoning is often ends with renal damage that eventually leads to death. Long-term complication is esophageal stricture.

**Treatment**

- Immediate emesis or lavage of ingested poison is important.
- Egg whites, milk, or gelatin solution should be given quickly, these serve as a source of protein for any phenol remaining in the stomach, so it will be precipitated instead of the protein of the stomach lining.
- Non absorbable oils (e.g. olive or mineral) are indicated to absorb phenol and, thus, reduce its chance for transport into the blood.
- Castor oil is frequently recommended as the antidote of choice because phenol has high affinity for it, and because castor oil produces a cathartic action which helps to remove the poison from the GIT quickly.
**Iodine**

Iodine has been used as a topical disinfectant since the early 1800s. It is also used to sterilize contaminated water by placing several drops of a 2% tincture in each liter of water.

Iodine is a direct protein precipitant which is corrosive to mucous membranes. In the intestine it is converted to the less toxic iodide, and it also is rapidly deactivated by foodstuff in the gut. Furthermore, it causes a strong vomiting reflex which removes much of the poison, all of these factors help to minimize its toxicity.

Major symptoms of ingestion are seen on the gastrointestinal tract, with nausea, vomiting, diarrhea, and gastroenteritis.

Ingestion can be quickly recognized by the appearance of brown stains in the mouth or on the lips, or of brown-colored vomitus.

Death from massive ingestions usually occurs within 48 hours from circulatory collapse due to shock, or from pulmonary edema which is caused by aspirations during emesis.

**Treatment**

- Gastric lavage with soluble starch should be undertaken to absorb iodine. Then, a 1-5% solution of sodium thiosulfate can be instilled to convert remaining iodine to iodide.
- Glucocorticosteroids should be administered as quickly as possible to reduce the chance of esophageal fibrosis.

---

**Quaternary Ammonium Compounds (QAC)**

Quaternary ammonium compounds are cellular cationic surfactants used in a wide variety of products such as disinfectants, bactericides, deodorants, and sanitizers.

All QACs produce similar symptoms through a similar mechanism.

Strong aqueous compounds produce superficial necrosis of mucous membranes with which they come into contact. Internally, they cause gastrointestinal tract erosion, ulceration, and hemorrhage throughout the entire intestine. They can also cause damage to the heart, liver, and kidney.

All QACs cause disinfection only to chemically clean areas. In the presence of any traces of soap, they are inactivated. Thus, soap serves as the best antidote for QAC poisoning.

Following skin contamination, the area should be thoroughly cleaned with soap. Following ingestion, a weak soap solution will inactivate any QAC and reduce its toxicity.