CRACKCast Episode – Hydrocarbons (Ch. 152 – 9th)

Episode Overview

Key Concepts:

- Aspiration is the major toxic risk of hydrocarbon poisoning.
- Hydrocarbons may cause systemic toxicity, burns, seizures, cardiac dysrhythmias, and altered mentation depending upon agent.
- Gastrointestinal decontamination is potentially harmful in cases of hydrocarbon ingestion and is contraindicated.
- Hydrocarbon inhalant abuse can cause CNS and cardiotoxic effects.
- Symptoms of toxicity, especially aspiration, can be delayed, so asymptomatic patients should be observed for 6 hours and given clear instructions to return if symptoms develop after discharge.
- In most cases of hydrocarbon ingestion or inhalation, symptomatic care along with close observation and monitoring are the cornerstones of management. Currently, there are no specific antidotes for hydrocarbons. Patients who have or develop pulmonary symptoms should have a chest radiograph performed.

Core Questions

1) List 5 chemical properties of hydrocarbons that increase toxicity
2) Describe the 3 toxicological effects of hydrocarbons
    a. What are 4 specific inhalational effects of HC on the lungs
    b. What are 3 chronic neurologic effects of HC exposure
3) What are 3 common clinical scenarios of HC toxicity
4) What is the risk of intentional GI ingestion? Who should be decontaminated by Gastric Lavage?
5) What is the management of Hydrocarbon toxicity?

Wise Cracks

1. What is sudden sniffing death syndrome?

Rosen's in Perspective

- Hydrocarbons = organic compounds that contain hydrogen and carbon
- Most hydrocarbons (eg, gasoline) are byproducts of crude oil and are therefore called petroleum distillates
- Essential oils such as turpentine or wormwood are derived from plants and not petroleum.

- Hydrocarbons are used as solvents and diluents in many products, such as household cosmetics and chemicals, pesticides, fuels, and essential oils.
- The two main categories of hydrocarbons are aliphatic (straight chain structures, such as propane) and aromatic (cyclic structures, such as toluene)
- Hydrocarbons can also have multiple non-organic side chains.
    - For example, halogenated hydrocarbons usually will have at least one bromide, chloride, fluoride, or iodide moiety (eg, carbon tetrachloride).
- Used as a solvent base for many toxic chemicals, such as insecticides, carburetor cleaner (methanol), and metals, which in turn can cause a separate distinct syndrome of poisoning
- Exposures to hydrocarbons are typically via inhalation, ingestion (with potential aspiration), and dermal.
    - Inhalation exposures are typically due to either intentional abuse of volatile hydrocarbons (huffing) or household and workplace exposures.
        - Ingestions are mostly due to accidental pediatric exposures, which also can lead to aspiration and pneumonitis.
    - Dermal exposures are from household or workplace exposures and rarely intentional.

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[1] List 5 chemical properties of hydrocarbons that increase toxicity

- Viscosity: Low = bad.
    - Viscosity is the capacity to resist flow or change.
    - Low viscosity allows a substance to spread rapidly, and low-viscosity hydrocarbons spread easily into the airway and lungs. (Eg such as furniture polish, gasoline, and lamp oil, have the highest potential risk of aspiration.)
    - Lubricants and mineral oil, conversely, have high viscosity and low toxicity potential.
- Volatility: High = bad (displaces O2!)
    - Volatility is a measure of a liquid's ability to evaporate to a gas or vapor
    - Hydrocarbons with high volatility can displace alveolar oxygen and cause hypoxia
    - Butane and propane are examples of hydrocarbons with high volatility
- Surface Tension: Low = bad
    - Surface tension is the capacity for a liquid to adhere to a surface.
    - **Low surface tension, like low viscosity, enables a substance (eg, turpentine) to disperse easily and may lead to pulmonary toxicity.**
- Side chain (structure): add stuff = bad stuff
    - Chemical side chains or substitutions often increase potential toxicity.
    - These include metals (eg, arsenic), halogens (eg, the chloride ions in carbon tetrachloride), and those found on aromatic structures (eg, the CH3 group in toluene).
- Lipophilicity can enhance blood brain barrier penetration resulting in CNS effects. = obvi bad!

[2] Describe the 3 toxicological effects of hydrocarbons

- Pulmonary - aspiration
- Cardiac - dysrhythmias
- CNS - ALOC / seizures; brain dysfunction with chronic use

Hydrocarbons cause direct lung injury, as well as displace oxygen and disrupt surfactant. Hydrocarbons can sensitize the myocardium to catecholamines, which can result in ventricular dysrhythmias and sudden death.

What are 4 specific inhalational effects of HC on the lungs? The reason we care is because the primary target organ for direct toxicity is the lungs! (Most hydrocarbons aren't very toxic to the GI system).

- Bronchospasm
- Displaced O2 from alveoli (volatile)
- Direct injury to alveoli/capillaries
- Inhibit surfactant function

The qualities (Box 152.1) of Hydrocarbons that may lead to aspiration and pneumonitis

- High volatility
- Low viscosity
- Low surface tension

What are 3 chronic neurologic effects of HC exposure

- Severe abnormalities in nervous system function, which include
    - Memory, attention and judgment deficits, peripheral neuropathy, cerebellar degeneration, neuropsychiatric disorders, chronic encephalopathy, and dementia.
- More than 50% of patients who abuse toluene for more than 10 years will have cerebral cortical atrophy with histologic changes that include loss of neurons, diffuse gliosis, and axonal degeneration

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[3] What are 3 common clinical scenarios of HC toxicity

- Respiratory distress - after aspiration of a hydrocarbon that was ingested
- CNS intoxication - euphoria, agitation, hallucinations, confusion, or bizarre behavior. This may progress to CNS depression and seizures. At risk for sudden sniffing death syndrome.
- Accidental dermal or inhaled (non-aspiration) respiratory exposure to hydrocarbons in the workplace or home.

See Table 152.1 in Rosens 9th Edition to assess the Spectrum of Hydrocarbon Toxicity

CHAMP is a long-standing mnemonic used to help identify hydrocarbons and their additives with systemic toxicity

- Camphor (neurotoxicity and seizures)
- Halogenated hydrocarbons (dysrhythmias and hepatotoxicity)
- Aromatic hydrocarbons (bone marrow suppression and leukemia)
- Metals (neurotoxicity)
- Pesticides (cholinergic crises, seizures, respiratory depression)

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[4] What is the risk of intentional GI ingestion? Who should be decontaminated by Gastric Lavage?

- Major risk is aspiration
- Lipoid pneumonia can also rarely develop after hydrocarbons coalesce in alveoli and become encapsulated by fibrous tissue reported in adults siphoning gasoline and from re-eating performances, also known as “fire-eater’s lung.”
- Gastrointestinal decontamination with gastric lavage or activated charcoal should be avoided. Most hydrocarbons are much more toxic to lungs than to the gastrointestinal tract, and emesis may lead to aspiration and pulmonary toxicity.

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[5] What is the management of Hydrocarbon toxicity?

Management of Hydrocarbons

- Resuscitate
- Risk Assessment
- Decontamination w/ water PRN
- CXR
- Oximetry
- ECG
- Cardiac Monitor
- Intrapulmonary/ECMO for refractory pneumonitis

A few keys in the resuscitation of hydrocarbons:

- *It is also postulated that catecholamines worsen or precipitate cardiac dysrhythmias and can be treated with short acting beta blockers,* ***such as esmolol, which are presumed to be protective. Epinephrine should be avoided in the acutely intoxicated patient for concern of precipitating an arrhythmia.***
- *Corticosteroids and antibiotics have not been shown to improve outcomes and are not indicated.*
- *In most cases of hydrocarbon ingestion or inhalation, symptomatic care along with close observation and monitoring are the cornerstones of management.*

Discharge criteria for hydrocarbon ingestion

- ❑ 6 hour asymptomatic period
- ❑ Non-lethal substance (Ie anything but CHAMP)

Which hydrocarbons are potentially lethal = CHAMP

- Camphor (neurotoxicity and seizures)
- Halogenated hydrocarbons (dysrhythmias and hepatotoxicity)
- Aromatic hydrocarbons (bone marrow suppression and leukemia)
- Metals (neurotoxicity)
- Pesticides (cholinergic crises, seizures, respiratory depression)

For the Disposition of Patients with known or suspected hydrocarbon exposure, see Box 152.3 in Rosens 9th edition. The summary of the table is as follows:

Observation

- All patients to be monitored for minimum of 6 hours
- Discharge criteria: asymptomatic without chest x-ray findings after 6 hours

Inpatient Admission

- Mild CNS depression, tachypnea, hypoxia, chest x-ray findings not resolved at 6 hours

Intensive Care Monitoring

- Moderate to severe CNS depression
- Significant respiratory distress
- Significant hypoxia and/or hypercarbia
- Requiring significant respiratory support (PPV / Mechanical Ventilation)
- History of cardiac dysrhythmias
- Hemodynamic instability

Wise Cracks

[1] What is sudden sniffing death syndrome?

Essentially this is sudden death after inhaling hydrocarbons

- Hydrocarbons cause myocardial sensitization to catecholamines
- Stimulus (ie cops) cause VF/VT
- ACLS modifications
  - Avoid epinephrine
  - Early beta-blockers (esmolol)
  - Avoid defibrillation