



The Toxic Home



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Where Do Accidents Happen?

- Most accidents happen within the home
- Adults vs. Children
- Toxic dump



Home Ave.



Clinical Toxicology

- American Association of Poison Control Centers-Toxic Exposure Surveillance System (AAPCC-TESS) 2009
- Statistics of morbidity and mortality

Top 5 Substances in Pediatric Exposures (< 6 years old)

1. Cosmetics	1. 13.0% (13.6%)
2. Analgesics	2. 9.7% (9.5%)
3. Cleaning Substances	3. 9.3% (9.6%)
4. Foreign bodies	4. 7.0% (7.2%)
5. Topical Preparations	5. 6.6% (7.1%)

Mortality

- 21/1158 fatalities involving children < 6
- Analgesics (including methadone), Button batteries, Kerosene, Lamp Oil, Cleaning products, Cough and Cold products, alcohols
- 1 intentional poisoning: oxycodone and Xanax



Today



- In the top 3:
- Cleaning substances
 - Caustics
 - Hydrocarbons
- Cosmetics and personal products

Caustic History



- Chevalier Jackson, endoscopist: Federal Caustic Act 1929
- 1970 Federal Hazardous Substances Act and the Poison Prevention Packaging Act: all corrosives > 10% must be packaged in childproof containers
- 1973: Legislation required childproof containers for all corrosives > 2%

What products are alkaline?

- Oven cleaner
- Drain cleaner
- Toilet bowl cleaner
- Glass cleaner
- Industrial cleaner
- Automatic dishwashing detergent
- Mold removal
- Clinitest tablets
- Denture cleaners
- Hair dyes
- Lime (cement)
- Alkaline batteries
- Bleach

What chemicals are alkaline?

- Sodium hydroxide
- Sodium hypochlorite
- Sodium carbonate
- Phosphate
- Silicate
- Ammonia

What defines an alkaline substance?

- Any product that forms more OH⁻ ions than H⁺ in solution
- Or
- An alkali is a proton acceptor or electron pair donor



What determines the strength of an alkaline product?

- Concentration
- Volume
- pKa
- pH
- TAR, the total amount of acid needed to restore neutral pH
- Solid or liquid
- Viscosity
- Transit time
- GI contents
- Premorbid condition of the GI tract

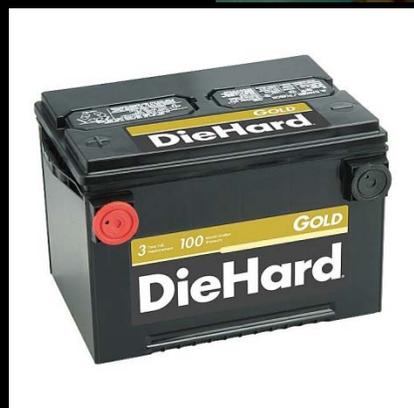
What are the tissue effects?



- Liquefaction necrosis
- Squamous epithelium of the esophagus
- Vulnerable to perforation days 3-14
- Stricture
- Squamous cell CA 20-40 times greater

What products are acids?

- Permanent wave neutralizers
- Toilet bowl cleaners
- Drain cleaners
- Automobile batteries
- Bleaching agents
- Rust removers



What chemicals are acids?

- Acetic acid
- Boric acid
- Carbolic acid
- Formic acid
- Hydrochloric acid
- Oxalic acid
- Nitric acid
- Phosphoric acid
- Sulfuric acid

What defines an acid substance?

- Any substance that donates protons
- $\text{HCl} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{Cl}^-$

What factors predict potency of an acid?

- pH
- Concentration
- Volume
- Duration of contact with tissue
- Stomach contents
- TAR not proven in acid injury

What are the tissue effects of an acid?

- Coagulation necrosis
- Esophagus and the stomach, palatible
- Magenstrasse flow along the lesser curvature
- Pylorospasm



Key Historical Questions

- Name, concentration, amount ingested
- Time
- Accidental vs. Suicidal
- Vomiting
- Trouble Breathing



Signs and Symptoms of Caustic Ingestions



- Stridor
- Drooling
- Vomiting
- Respiratory Distress
- Oropharyngeal Pain
- Odynophagia
- Dysphagia
- Chest, abdominal, epigastric pain
- Oropharyngeal burns
- Hypotension
- Metabolic acidosis
- DIC

Do signs and symptoms predict caustic injury?

NO

Studies

- Gaudreault et al, 1982: 80 children 9 months to 13 years, w/o symptoms, 12% had grade II lesions, 1.2% of the asymptomatic patients had a stricture
- Vomiting 33%, dysphagia 25%, salivation 24%, abdominal pain 24% were most frequently associated with grade II-III lesions

More Studies

- Previtera et al, 1990, predictive value of CLO burns in predicting GI burns, 36/96 (37.5%) children no signs of CLO, but had burns in one or more visceral sites
- Gorman et al, 1991, 2 year prospective study, 7 PC, all pts with significant burns were symptomatic, but no one symptom was predictive

Should GI decontamination be used?

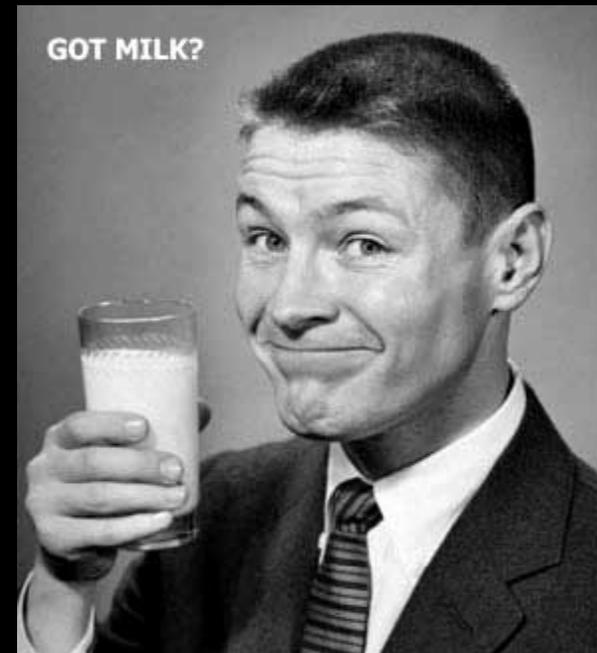
- Ipecac
 - Lavage
 - Charcoal
 - Cathartic
 - WBI
- No
 - Yes and No
 - No, Why?
 - No
 - No



What about dilutional therapy?



- Dilutes the concentration of the caustic
- Animal studies show little increase in heat or pressure when given in alkali ingestions
- Limited to the first few minutes after exposure
- Solids make the most sense

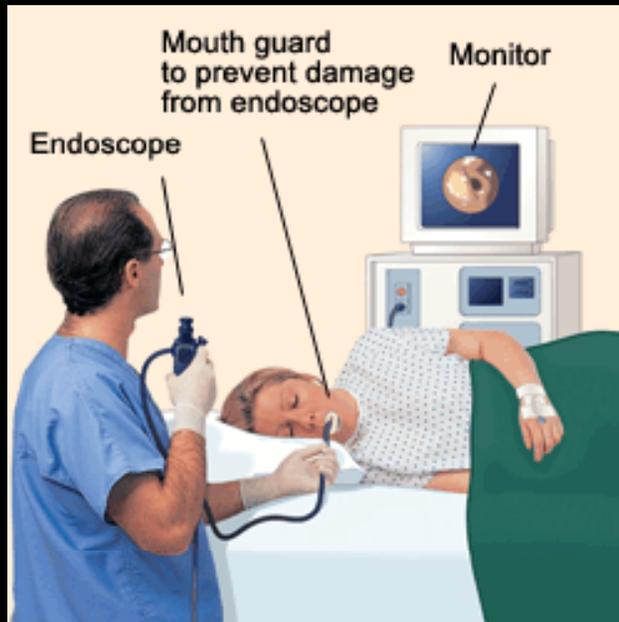


Neutralization

- Exothermic reaction
- Requires a large volume
- Useful in the first few minutes



Endoscopy



- Airway first
- Indications: Stridor, Symptomatic child, Intentional adult,
- Best if within 12 hours, no later than 24
- Risk of perforation, > 3 days
- Contraindications, surgery, asymptomatic child

Grading of esophageal injury

- Grade I: superficial mucosal injury, mild erythema and edema (think sunburn)
- Grade IIa: transmucosal with significant erythema, ulcerations, white exudates
- Grade IIb: transmucosal, circumferential, prone to strictures
- Grade III: full thickness transmural necrosis, dusky or black in appearance, associated with perforation, stricture, and bleeding

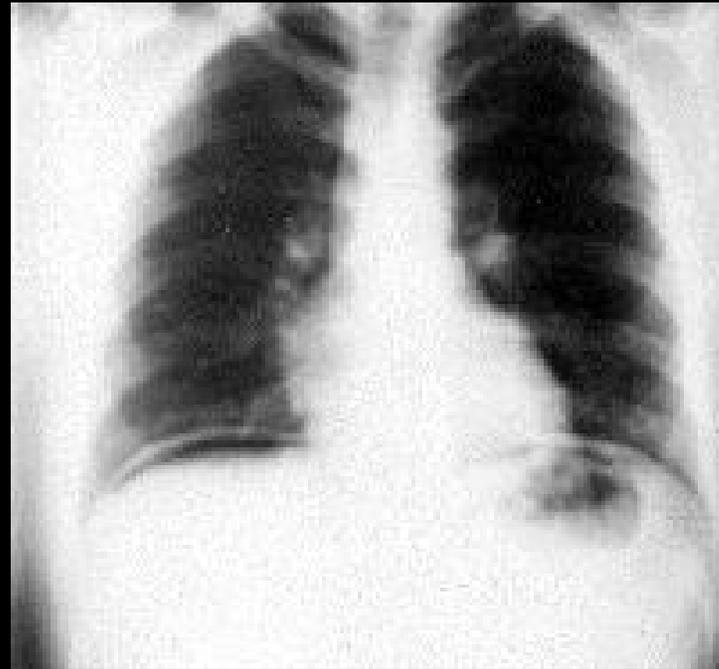
What is the use of endoscopy?

- Disposition: depending on the grade
- Treatment: NPO, NGT, G-tube, HAL, surgery, steroids
- Prognosis: Stricture



Radiography

- Only helpful for detection of perforation
- Water soluble contrast, increased risk of perforation
- Barium better at detecting perforation



When is surgery indicated?



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- Hemodynamic instability
- Perforation
- Peritonitis
- Mediastinitis
- GI hemorrhage
- Grade III lesions

Are steroids ever not controversial?

- 1st degree burns: not needed, no strictures
- 3rd degree burns: do not change outcome of strictures
- 2nd degree burns: another story
- Very little data in acids, most studies done on alkali injury



Anderson et al, 1990

- 18 year prospective study, median age 2
- 60 children, 10/31 children treated and 11/29 developed strictures
- The need for esophageal replacement correlated with degree of injury
- Type II error
- Brain abscess of a child on steroids

Howell et al, 1992

- 361 patients, adults/children, retrospective study from 1956-91
- 2nd/3rd degree treated 54/228 (24%) strictures
- 2nd/3rd degree not treated 13/25 (52%)
- Small number of NT, retrospective, undifferentiated injury score

Antibiotics?



- Only if signs of infection or always with steroid use

Experimental / Lathrogens

- NAC
- Penicillamine
- Colchicine
- Epidermal growth factor
- Interferon gamma
- Estradiol-progesterone

Sequelae

- Strictures 2-4 weeks
- Bougienage 3-4 weeks
- Colonic interposition
- Infection
- Fistula formation, ie, aorta
- Alkaline burns may cause squamous cell CA



Button Batteries

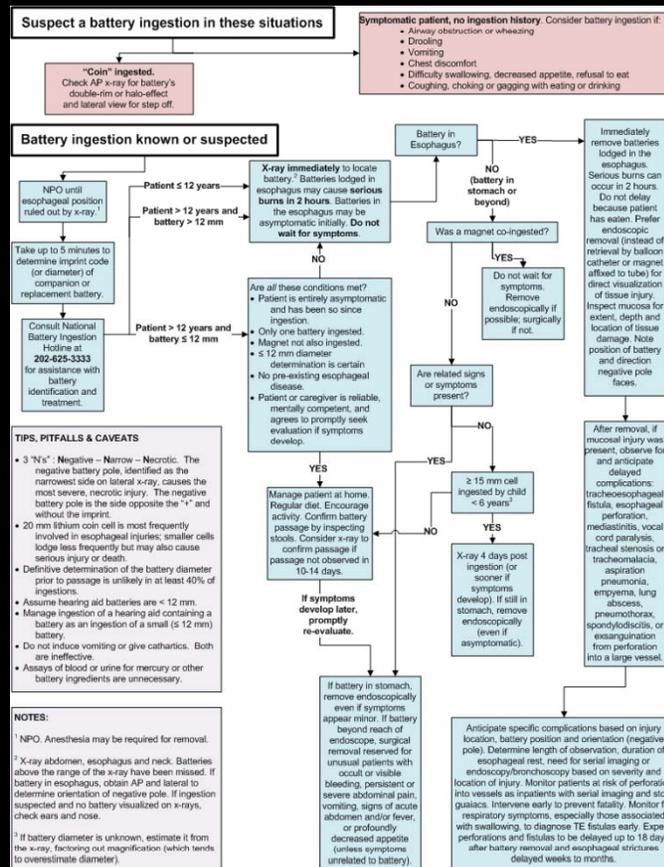


- Contain sodium and potassium hydroxide, range in size from 6.8-23 mm
- Review of 2,382 cases 86% passed within 4 days
- 2 patients developed strictures, 10% had break in the seal
- Fatal fistula to the aorta in 2 cases

Management

- Airway, AP, lat neck, CXR, abdominal XR
- In airway = bronchoscopy
- In esophagus = nitrates, CCA, glucagon, (no studies), ipecac, Foley...ENDOSCOPY
- In stomach, < 6 and batt > 15 mm reassess in 24 hours, possibly WBI
- In intestine 99% will pass in 7 days

Algorithm



Intermission



Don't Try This at Home!



What are hydrocarbons?

- Organic compounds composed primarily of Carbon and Hydrogen
- Range in length from 1 to 60 Carbon atoms
- Can be Aliphatic (Straight or branched chains)
- Or can be Cyclic (closed rings)

Hydrocarbons (Common Household Products)

- Gasoline
- Home heating oil
- Mineral oil/mineral spirits
- Paint stripper/thinner
- Spray paints
- Furniture polishes
- Correction fluids (white-out)



A Pediatric Epidemic?

- 60% of exposures pediatric
- 18% of all pediatric admissions for poisoning
- 90% of hydrocarbon-related deaths children < 5 years

Case Presentation

- 1 yo male brought to the ED 2 hours after ingesting 2 oz of pine oil 60% solution
- Foaming at the mouth, lethargic, unresponsive

PE

- Afebrile, HR 103, good cap refill, “normal” respirations
- NEURO: responds to deep painful stimuli
- EXTR: scars L forearm and L leg

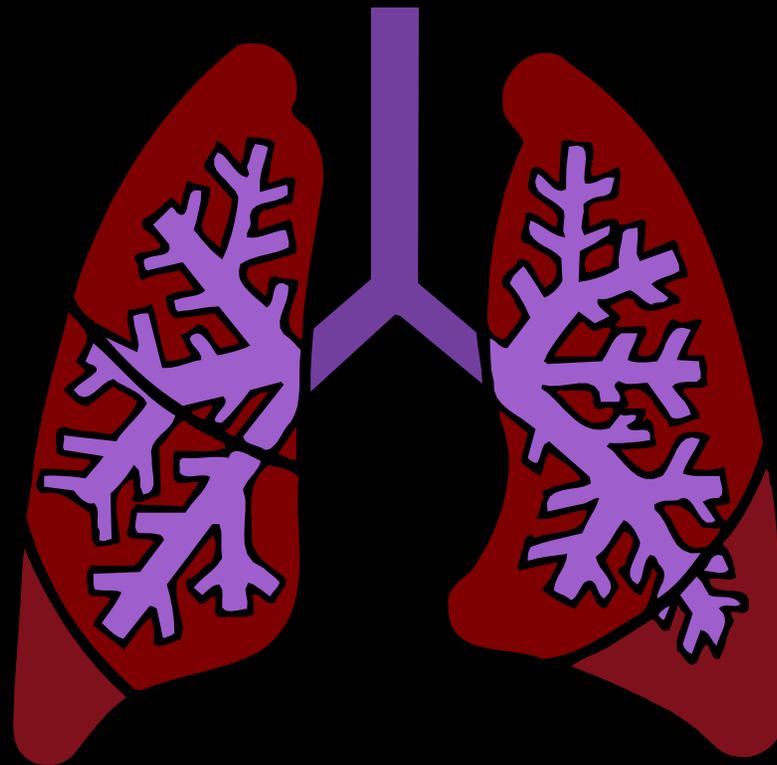
Laboratory/Radiology

- ABG 7.4/32/255/20/99% on vent
- Everything else NML

Hospital Course

- Day 1 Recommended GI consult for caustic potential
- Day 2 WBC 24.3, pt extubated
- Day 3 afebrile, tolerating po

What is the main organ of toxicity?



How do hydrocarbons cause pulmonary toxicity?

- GI absorption or aspiration?
- What are the exceptions?
- Mechanism is a combination of direct toxicity and disruption of the surfactant



What are the risk factors for aspiration?

- Viscosity
- Surface tension
- Volatility
- SSU (Saybolt seconds universal)

SSU < 60 strong risk for aspiration,
(aromatics, halogenated, naphtha,
turpentine, gasoline, mineral spirits,
kerosene), > 100 less risk

Signs and Symptoms

- Pulmonary: cough, gagging, choking, 30 min
- Severe: rales, rhonchi, bronchospasm, hypoxia(V/Q mismatch), pulmonary edema, methemoglobinemia
- CXR may not show infiltrates for 24 hours
- May have long term small-airway obstruction

Signs and Symptoms



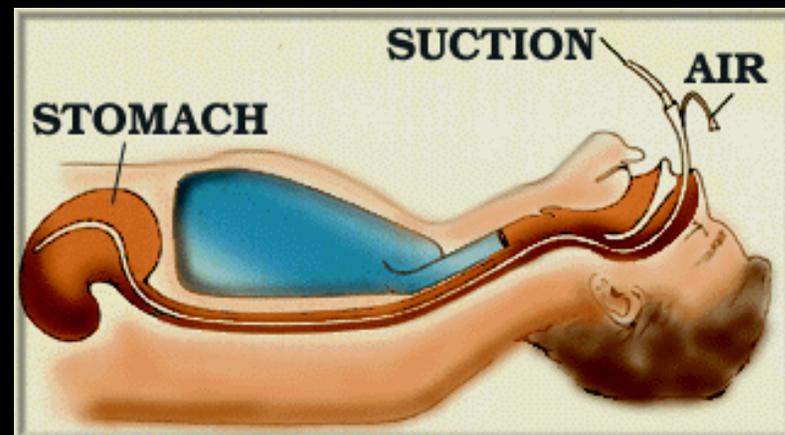
- CNS depression: pulmonary absorption + hypoxia
- GI: N/V, corrosion
- Cardiac: Myocardial sensitization to catecholamines
- Derm: rash-full thickness burns

Gastric Decontamination

- Ipecac
 - Lavage
 - Charcoal
 - Cathartic
 - WBI
- No
 - Yes and no
 - No
 - No
 - No

Indications for GENTLE NGT

- > 30 ml
- Intentional ingestions
- C: camphor
- H: halogenated
- A: aromatic
- M: metals
- P: pesticides



Antibiotics

- Prophylactic antibiotics are not indicated
- Antibiotics should be started if elevated temp, WBC, after 40 hours or a positive sputum culture

Steroids

Prophylactic steroids are not effective

Disposition



- After 6 hours, asymptomatic patients or patients with resolution of symptoms may be discharged, with normal CXR
- Admit all others

Severe Toxicity

- Intubation or CPAP, BiPAP to improve oxygenation when alveoli/surfactant are damaged
- β - agonists for bronchospasm, no epinephrine or nonselective α or β agonist

Special Halogenated Hydrocarbons

- Methylene Chloride, paint strippers, delayed 8-13 hour production of CO
- Chloroform, only industry, hepatotoxic
- Carbon tetrachloride, only industry hepatotoxic

More Special Halogenated Hydrocarbons

- Trichlorethane/ethylene, White Out, spot remover, adhesive removal, strippers, CNS, cardiac
- Tetrachloroethylene, dry cleaning, CNS, cardiac
- Vinyl chloride, controlled, angiosarcoma of the liver



Aromatic Hydrocarbons Quick and Dirty

- Benzene: euphoria, CNS depression, cardiac, pulmonary edema, chronic bone marrow toxicity, AML, aplastic anemia
- Toluene: Same CNS, cardiac; hyperchloremic metabolic acidosis, hypokalemia, hypophosphatemia, muscle weakness, rhabdo, AG

Quicker

- Xylene: Same CNS and cardiac; HA, ataxia, coma, respiratory arrest, skin and mucosal, and respiratory irritant

Rapid Fire Toxic House

- Hair Colors semi-permanent vs. permanent
- Permanent is H₂O₂ 12% can be caustic
- Ammonia emetic, Grecian formula- lead
- Skin, eyes; irrigation

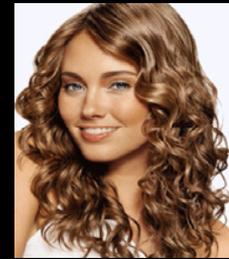


Hair Lighteners

- Mild Toxicity
- Ammonia, H₂O₂, potassium or sodium persulfate, foul odor and taste



Hair Waving Agents



- Softeners: thioglycolic acids mod tox= mucosal irritation, N/V/D; ammonium and sodium sulfite ph 7.0-8.5, got milk
- Neutralizers: Bromates 2% high tox = GI symptoms in 30 min, otic and renal toxicity

Hair Straighteners



- Contain NaOH 1-3% pH 13, Extreme toxic=caustic, treatment as normal alkali ingestion
- Dermal and ocular exposures treat with irrigation

Hair Spray



- Liquid pump
- Aerosol with butane, isobutane, propane
- Both hold the hair with resins
- The solvent is 95% of the spray, which contains EtOH
- Hypersensitivity

Shampoos and Conditioners

- Mild toxicity= GI upset
- Hypersensitivity



Soaps, Bubble Baths, Bath Oils

- Most soap and bubble bath mild GI upset, contain anionic surfactant and fragrances
- Most bath oil is mineral oil or vegetable oil, but essential oils like sage, eucalyptus, and pennyroyal can cause GI distress, CNS depression, and lipoid pneumonia, possibly hepatitis

Bath Salt (for actual use in bath)

- Sodium chloride, only toxic if taken in large amounts, electrolyte disturbances



Colognes, Perfumes, Toilet Water

- Depends on alcohol content
- Can be 95%



Body Paint and Makeup



- Body paint depends on the alcohol content
- Makeup = nontoxic, waxes, oils, fats, water
- Blushes contain talcs but amount is negligible

Nail Polish



- Low toxicity = GI upset
- Contains xylene, toluene, ethanol, methanol
- So small it is not toxic like big brother

Nail Polish Remover

- Mild Toxicity contains ethanol and acetone
- CNS depression



Acrylic Nail Remover

- Mega toxic
- Acetonitrile is metabolized by P450 system to cyanide
- Symptoms can be delayed 3-24 hours



Baby Powder

- Carbonates, stearates, fragrances, can cause pneumonitis if inhaled in large quantities



Toothpaste



- Mild toxicity, GI upset, contains stannous fluoride and sodium monofluorophosphate which have low water solubility

Denture



- Non-bleach non toxic
- Bleach containing potassium persulfate and sodium perborate
- Sodium perborate is metabolized to borate and peroxide causing, lobster skin, CNS, ATN



Mouthwash

- Depends on alcohol content, some contain methylsalicylate



Soaps, Creams, Deodorants, and Lotions

- Mild tox, some lotions have 10 % alcohol
- Antiperspirants contain aluminum hydroxychloride to inhibit eccrine glands



Depilatories

- Soluble Barium extremely toxic
- Sodium hydroxide and sodium calcium hydroxide moderately toxic caustics



Skin Lighteners

- If large amounts ingested, very toxic
- Contains hydroquinones 5% causing dyspnea, GI distress, cyanosis, seizures
- Treatment is supportive care

Thanks





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