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# Ingestions, Intoxications, and the Critically Ill Child

# Poisoning in Children

- 1 million cases of exposure to toxins in children younger than 6 years reported in the U.S. In 1993
- estimated that another 1 million exposures to toxins not reported
- 1% have moderate or major life-threatening symptoms
- 60-100 deaths annually in the U.S

# Poisoning in Children Less Than 5 Years Old

- accounts for 85-90% of pediatric poisoning
- is generally accidental
- secondary to exploratory behavior and lack of supervision
- tend to involve single agent ingestions

# Poisoning in Children Over 5 Years Old

- accounts for 10-15% of pediatric poisoning
- is generally intentional
- secondary to suicide attempts or gestures, or to intoxications and inadvertent overdose
- tend to involve multiple agent ingestions

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# General Concepts for Pediatric Poisoning

- Prevention
- Initial Stabilization
- Diagnosis
- Specific Antidotes

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# Management of the Poisoned Child

- Treat the Patient, Not the Poison
  - patient-specific treatment is safer, less expensive, and more effective

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# Management of the Poisoned Child

- Stabilization
  - Airway
  - Breathing
  - Circulation
  - Disability (neurologic)

# Management of the Poisoned Child

- Respiratory Failure
  - airway obstruction from secretions, refluxed gastric contents, airway muscle relaxation
  - respiratory muscle rigidity
  - loss of respiratory drive
  - pulmonary edema

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# Management of the Poisoned Child

- Cardiovascular Collapse
  - arteriolar dilation
  - venous dilation
  - myocardial depression
  - dysrhythmias

# Management of the Poisoned Child

- Neurologic failure
  - hypoxic injury
  - electrolyte imbalance
  - direct drug effect
  - rule out head and cervical spine injury

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# Diagnosis of Poisoning

- History
- Physical Examination
- Laboratory Studies



# History

- identification of possible intoxicating agent
- mode of intoxication
- maximum potential dose
- time since exposure
- maintain index of suspicion



# Physical Examination

- Vital signs
- Odors
- Skin
- Mucous Membranes
- Cardiac
- Respiratory
- Gastrointestinal
- Central Nervous System

# Odor

- bitter almond
- acetone
- garlic
- alcohol
- petroleum
- cyanide
- isopropyl alcohol, methanol, ASA
- arsenic, organophosphates
- ethanol, methanol
- petroleum distillates

# Skin

- cyanosis (methemoglobinemia)
- red flush
- sweating
- dry
- jaundice
- purpura
- nitrates nitrites, local anesthetics
- CO, cyanide, anticholinergics
- organophosphates, amphetamine, cocaine
- anticholinergics
- acetaminophen, mushrooms, CC14
- ASA, warfarin, snakebite

# Mucous Membranes

- dry
- salivation
- oral lesions
- lacrimation
- anticholinergics
- organophosphates
- corrosives
- caustics,  
organophosphates,  
irritant gas

# Cardiac

- SVT
- PVC, ventricular tachycardia
- prolonged Q-T interval
- aminophylline, anticholinergics, TCA
- digitalis, TCA, sympathomimetics, cocaine
- TCA, phenothiazine

# Respiratory

- wheezing
- rales (pulmonary edema, pneumonia)
- organophosphates
- salicylates, narcotics, sympathomimetics, hydrocarbons



# Gastrointestinal

- hyperperistalsis
- decreased bowel sounds
- blood in stool
- cholinergics
- narcotics, anticholinergics
- ASA, iron, phosphorus



# Central Nervous System

- miosis
- mydriasis
- blindness
- fasciculation
- nystagmus
- myoclonus, rigidity
- narcotics, barbituates, benzodiazepines
- anticholinergics, cocaine, TCA
- methanol
- organophosphates
- ethanol, PCP, CO, barbituates
- anticholinergics, haldol

# Laboratory Studies

- decreased hgb sat with normal/increased PaO<sub>2</sub>
- elevated anion gap
- elevated osmolar gap
- CO; nitrates, nitrites, local anesthetics (methemoglobin)
- alcohols, salicylates, isoniazid, iron, CO, cyanide
- ethanol, methanol, isopropyl alcohol, ethylene glycol

# Laboratory Studies

- hypoglycemia
  - insulin, ethanol, isopropyl alcohol, isoniazid, acetaminophen, ASA
- hyperglycemia
  - ASA, isoniazid, organophosphates, iron
- hypocalcemia
  - ethylene glycol, methanol

# Laboratory Studies

- oxalic acid  
crystalluria
- ketonuria
- boiled urine/10%  
ferric chloride  
(purple)
- ethylene glycol
- isopropyl alcohol,  
ethanol, salicylates
- Asa

# Laboratory Studies

- Radiographs
  - iron
  - arsenic
  - phenothiazines (some)
  - chloral hydrate tablets



# Laboratory Studies

- qualitative drug levels
- toxicology screening tests
- urine versus blood





# Treatment

- Presumptive Therapies
- Prevention of Further Drug Absorption
- Increased Elimination
- Specific Antidotes



# Presumptive Therapies

- dextrose 0.5-1.0 g/kg IV
- glucagon 0.1 mg/kg (max 1 mg) IM
- naloxone 10 mcg/kg IV
- flumazenil 10 mcg/kg IV

# Presumptive Therapies

- oxygen
- carbon monoxide
- amyl nitrite, sodium nitrite, sodium thiosulfate
- cyanide
- methylene blue
- methemoglobin
- atropine
- organophosphate, carbamate

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# Prevention of Further Drug Absorption

- removal from inhaled intoxicant
- surface decontamination
  - removal of clothing
  - skin washing
  - eye irrigation

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# Prevention of Further Drug Absorption

- gastrointestinal tract decontamination
  - emesis
  - gastric lavage
  - activated charcoal
  - cathartics
  - whole bowel irrigation

# Emesis

- most effective when performed soon after ingestion, may still be of use with delayed gastric emptying
- contraindications: hydrocarbons, altered mental status, unprotected airway, caustic agents
- syrup of ipecac

# Gastric Lavage

- most effective when performed soon after ingestion, may still be of use with delayed gastric emptying
- large bore orogastric tube
- 0.45%-0.9% normal saline until clear
- contraindications: caustic agents, hydrocarbons, altered mental status, unprotected airway

# Activated Charcoal

- effectively adsorbs many toxins, decreasing their systemic absorption
- provides 1000 square meters surface area per gram charcoal
- acids, bases, cyanide, iron, lithium, hydrocarbons not well adsorbed
- multiple dose, first dose with cathartic
- use with n-acetylcysteine?

# Cathartics

- saline cathartics (magnesium citrate, magnesium sulfate, sodium sulfate)
- reduce intestinal transit time
- most effective in combination with charcoal

# Whole Bowel Irrigation

- theoretically rinses toxin from the GI tract, may create a concentration gradient to allow toxin to diffuse back into the GI tract
- sodium sulfate and polyethylene glycol electrolyte solution
- continuous infusion until rectal effluent is clear

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# Increased Elimination

- forced diuresis +/- urinary ph control
- dialysis
- hemoperfusion
- exchange transfusion
- drug antibodies

# Forced Diuresis +/- Urinary Ph Control

- requires that the drug be renally excreted, poorly protein bound, and have an appropriate pk
- result is reduction of concentration gradient in distal segment of the nephron and increase in the proportion of ionized drug
- many potential complications

# Dialysis

- movement of solutes through a semipermeable membrane along a concentration gradient
- success related to drug size, solubility, volume of distribution, and protein binding

# Hemoperfusion

- exposure of blood to large surface areas of encased activated charcoal or resins
- drug size, solubility, and the degree of protein binding are not limiting factors (vs dialysis)
- volume of distribution may be limiting
- problems with venous access, hypotension, thrombocytopenia, electrolyte disturbances, hypothermia

# Drug Antibodies

- specific antibodies to bind drug and enhance elimination
- digoxin-specific fab antibody fragments

# Specific Antidotes

- pharmacologic antagonists or chelating agents exist for certain poisons
- the majority of poisonings do not have a specific antidote, and management is supportive

# Organophosphates

- include nerve gases and insecticides
- rapidly absorbed via skin, GI, lungs, mucous membranes
- irreversible binding to acetylcholinesterase
- treatment: supportive, atropine, pralidoxime

# Tricyclic Antidepressants

- low toxic-therapeutic index
- well absorbed from small bowel, large volume of distribution
- anticholinergic, amine pump blockade, myocardial depressant
- CNS depression, seizures, hypotension, dysrhythmias
- treatment: supportive, anticonvulsants, serum alkalization, lidocaine, dilantin, pacing

# Methanol

- extremely toxic at small volumes, rapid GI absorption
- methanol --> formaldehyde --> formic acid via alcohol dehydrogenase
- CNS depression, optic atrophy
- treatment: supportive, ethanol infusion, dialysis

# Isopropyl Alcohol

- rubbing alcohol, small volumes very toxic
- rapid GI absorption, large volume of distribution
- CNS depression, GI symptoms, hypotension, pulmonary edema, respiratory arrest
- treatment: supportive, consider dialysis

# Cyanide

- byproduct of polymer combustion, nitroprusside
- inhibition of oxidative phosphorylation-binding to cytochrome oxidase
- nonspecific symptoms from cellular hypoxia
- treatment: supportive, specific antidotal therapy with sodium nitrite and sodium thiosulfate

# Acetaminophen

- Hepatic metabolism, approximately 4% via toxic intermediates that are inactivated by glutathione
- Intoxication depletes glutathione, increases toxic metabolite
- Clinical manifestations: 4 stages
  - Stage 1: GI symptoms
  - Stage 2: apparent recovery
  - Stage 3: liver injury
  - Stage 4: recovery
- Treatment: supportive, N acetylcysteine

# Salicylate

- salicylic acid is the toxic metabolite
- tinnitus, nausea, vomiting, tachycardia, hyperventilation, CNS depression, seizures
- uncoupling of oxidative phosphorylation, interference with lipid, carbohydrate, and protein metabolism
- treatment: stabilization, alkaline diuresis, dialysis