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
General Concepts for Pediatric Poisoning

- Prevention
- Initial Stabilization
- Diagnosis
- Specific Antidotes
Management of the Poisoned Child

• Treat the Patient, Not the Poison
  --patient-specific treatment is safer, less expensive, and more effective
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
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
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 PaO2
- 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
- hyperglycemia
- hypocalcemia

- insulin, ethanol, isopropyl alcohol, isoniazid, acetaminophen, ASA
- ASA, isoniazid, organophosphates, iron
- 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
- amyl nitrite, sodium nitrite, sodium thiosulfate
- methylene blue
- atropine

- carbon monoxide
- cyanide
- methemoglobin
- organophosphate, carbamate
Prevention of Further Drug Absorption

- removal from inhaled intoxicant
- surface decontamination
  --removal of clothing
  --skin washing
  --eye irrigation
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
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 alkalinization, lidocaine, dilantin, pacing
Methanol

- extremely toxic at small volumes, rapid GI absorption
- methanol $\rightarrow$ formaldehyde $\rightarrow$ 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