

**Common antidotes and adult doses-II**

Poison/syndrome	Antidote(s)	Adult dose
Heparin	Protamine sulfate	1 mg neutralizes 90-115 U heparin; Initial dose: 1 mg/min to total dose 200 mg in 2 h
Hydrofluoric Acid	Calcium gluconate	1) Topical Ca gluconate gel 3 percent applied for 1-2 days; or 2) Intradermal or SQ Ca gluconate injection 5 percent at burn site (0.5 mL/cm <sup>2</sup> burn area) 3) Regional intravenous (Bier block): 10 ml 10 percent in 40 mL NS injected locally in venous system x 20-30 min 4) Intraarterial Ca gluc 10 percent: 10-20 ml in 40 ml NS over 4 hrs; repeat as necessary until pain relief
Iron	Deferoxamine (Desferol)	15 mg/kg/h IV infusion until urine color clears or patient clinically well (not to exceed 6 gm/24 h)
Isoniazid	Pyridoxine (Vitamin B6)	Initial dose: 1 gm pyridoxine for every gm INH ingested or empiric 5 gm IV over 10 min if amount ingested unknown
Lead	2,3-dimercaptosuccinic acid [DMSA] (Succimer); 100 mg cpsl	30 mg/kg po in three divided doses x 5 days, then 20 mg/kg in twice daily doses x 14 days; repeat therapy prn after 2 week rebound
Mercury Arsenic Gold	British antilewisite, dimercaprol (BAL); in peanut oil	Initial dose: 4-6 mg/kg IM every 4-6 h x 2 days
Methemoglobinemia	Methylene blue (1 percent solution)	Initial dose: 1-2 mg/kg (0.1-0.2 mL/kg) IV over 5 min; repeat prn
Opiates	Naloxone (Narcan) Nalmefene, naltrexone	Initial dose: 0.1-2.0 mg IV push (opioid dependent patients should receive 0.1 mg IV every 30-60 sec until clinical response); synthetic opiates may need up to 10 mg for initial reversal dose
Organophosphates Carbamates Nerve agents	1) Atropine 2) Pralidoxime [2-PAM] (Protopam)	1) Initial dose: 0.5-2.0 mg IV; repeat q 3-5 min until sweat and secretions clear 2) Initial dose: 1 gm IV over 15 min, then IV infusion of 3-4 mg/kg/h for 24-72 hrs or until clinical toxicity resolves
Sulfonylurea	Octreotide (Sandostatin) + dextrose	Initial dose: 50-100 mcg SQ or IV, then 50 mcg q 12 h until euglycemia maintained without supplemental dextrose
Tricyclic antidepressants	Sodium bicarbonate (NaHCO <sub>3</sub> )	Initial dose: 1-2 ampules (50-100 mEq) IV push, then IV infusion to maintain blood pH 7.45-7.55 and PCO <sub>2</sub> ≈ 30 mmHg (Usual drip: 3 amps NaHCO <sub>3</sub> in 1 L DSW infused at 200-250 mL/h)

**Common antidotes and adult doses-I**

Poison/syndrome	Antidote(s)	Adult dose
Acetaminophen	N-acetylcysteine (Mucumyst 20%)	Initial oral dose: 140 mg/kg, then 70 mg/kg q 4h x 17 doses
Anticholinergic agents	Physostigmine (Antilirium)	Initial dose: 0.5-2.0 mg slow IV over 3-5 min
Benzodiazepines	Flumazenil (Romazicon)	Initial dose: 0.1-0.2 mg IV over 30-60 sec, repeat 0.1-0.2 mg IV every minute prn up to 1.0 mg
Beta-blockers	1) Glucagon 2) Calcium 3) Insulin + dextrose	1) Initial dose: 5-10 mg IV bolus, then 2-10 mg/hr IV infusion 2) Calcium chloride 10%: 1 gm (10 cc) IV; repeat as necessary 3) Insulin load: 0.5 units/kg IV bolus, then 0.5-1.0 U/kg/h IV Dextrose 10% IV infusion (with KCl) - titrate to euglycemia
Calcium-channel blockers	1) Calcium 2) Glucagon 3) Insulin + dextrose	1) Calcium chloride 10%: 1-4 gm (10-40 cc) IV; repeat as necessary 2) Initial dose: 5-10 mg IV bolus, then 2-10 mg/hr IV infusion 3) Insulin load: 0.5 units/kg IV bolus, then 0.5-1.0 U/kg/h IV
Carbon monoxide	Oxygen ± hyperbaric chamber	100% oxygen by ventilator or NRB; high-flow oxygen by tight-fitting facemask
Crotalid snakebite	Wyeth polyvalent crotalidae antivenin (equine)	Mild: 3-5 vials; moderate: 6-10 vials; severe: 10-20 vials Mix reconstituted antivenin in 1000 ml NS over 4-6 hours
Cyanide	1) Amyl nitrate pearls 2) Sodium nitrite (3% solution) 3) Sodium thiosulfate (25%)	1) One ampule by inhalation for 15 sec every 3 min until IV access 2) 10 ml (300 mg) IV over 3 min 3) 50 ml (12.5 g) IV over 10 min
Digitalis	Digoxin immune Fab (Digibind)	1) (# mg ingested x 0.8) ÷ 0.6 = #vials needed 2) (Dig concentration [in ng/ml] x 5.6 x kg [weight]) ÷ 600 = #vials 3) Empiric dose: 10 vials (acute poisoning); 1-3 vials (chronic) 4) Reconstitute Digibind in NS and administer IV over 5-30 min
Ethylene glycol Methanol	1) Ethanol 10% in DSW ± hemodialysis 2) Fomepizole [4-MP] (Antizol) ± hemodialysis	1) Initial load: 10 ml/kg IV of 10% ethanol over 30 min, then 1.5 ml/kg IV infusion (titrate drip to serum ethanol 100 mg/dL); double to triple infusion during hemodialysis 2) Initial load: 15 mg/kg IV over 30 min, then 10 mg/kg every 12 hours IV over 30 min (re-bolus during HD)

## Overview of aspirin intoxication

### Clinical and laboratory features

Common: tachypnea, tinnitus, nausea, vomiting, acid-base abnormalities

Severe cases: hyperthermia, altered mental status, pulmonary edema

### Diagnostic evaluation

Salicylate level, arterial blood gas, basic metabolic panel (Chem-7), chest radiograph

Repeat salicylate level every two hours until level declining

Repeat blood gas every two hours until acid-base status stable or improving

### Treatment

#### Avoid intubation if possible

Administer supplemental oxygen as needed

Volume resuscitate unless cerebral or pulmonary edema is present

Administer multiple doses of activated charcoal (first dose: 1 g/kg up to 50 grams PO)

Administer supplemental glucose in patients with altered mental status, even if serum glucose concentration is normal

Alkalinize with sodium bicarbonate

-Bolus therapy: NaHCO<sub>3</sub>, 2-3 meq/kg IV push (adults)

-Maintenance therapy: 132 meq NaHCO<sub>3</sub> in 1 L of D5W, run at 250 cc/h (adults) or 50 to 100 meq NaHCO<sub>3</sub> in 1 L D5W, run at 1.5 to 2 times maintenance (children)

-DO NOT USE ACETAZOLAMIDE TO ALKALINIZE THE URINE

Alert nephrology team early in the patients clinical course; consider hemodialysis for:

Profoundly altered mental status

Pulmonary or cerebral edema

Renal insufficiency that interferes with salicylate excretion

Fluid overload that prevents the administration of sodium bicarbonate

A plasma salicylate concentration >100 mg/dL (7.2 mmol/L)

Clinical deterioration despite aggressive and appropriate supportive care

## Drug-induced ocular abnormalities

### Mydriasis

#### Sympathomimetics

Cocaine

Caffeine

Ephedrine

Amphetamines

Methylphenidate

#### Anticholinergics

Atropine

Scopolamine

TCA's

Antihistamines

Antiparkinson agents

Muscle relaxants

Antispasmodics

Phenothiazines (some)

Plants (with belladonna alkaloids)

#### Hallucinogens

LSD

Mescaline

Psilocybin

Designer amphetamines

#### Miscellaneous

Glutethimide

Alcohols

MAOIs

Nicotine

Serotonin syndrome

#### Drug withdrawal states

### Miosis

#### Opioids

Heroin

Morphine

Hydromorphone

Oxycodone

Hydrocodone

Codeine

Propoxyphene

#### Sedative-hypnotics

Barbiturates

Benzodiazepines

Alcohols (with deep coma)

Zolpidem

#### Cholinergics

Nerve agents

Organophosphate insecticides

Carbamate insecticides

Pilocarpine

Edrophonium

Physostigmine

#### Sympatholytics

Clonidine

Oxymetazoline

Tetrahydrozoline

Antipsychotics

#### Miscellaneous

Phencyclidine

### Nystagmus

Barbiturates

Carbamazepine

Phencyclidine

Phenytoin

Lithium

Ethanol

Toxic alcohols

Organophosphates

Strychnine

MAOIs

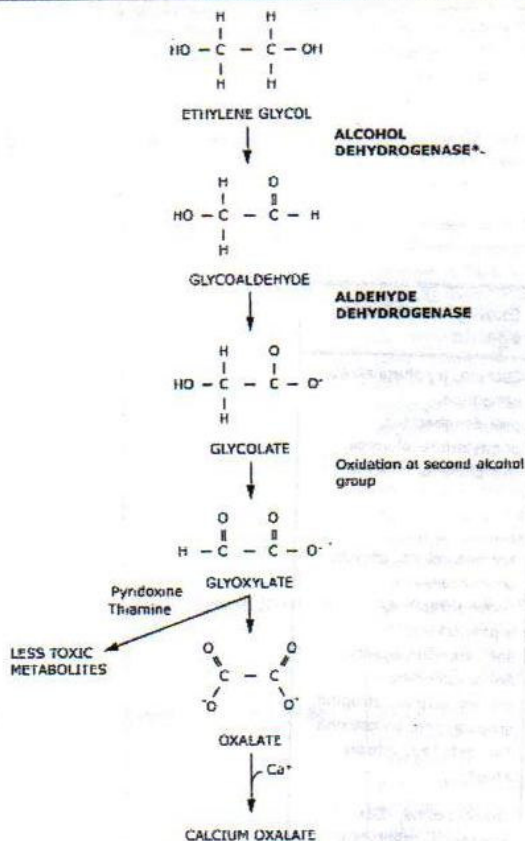
Serotonin syndrome

Ketamine

## Drug-associated odors

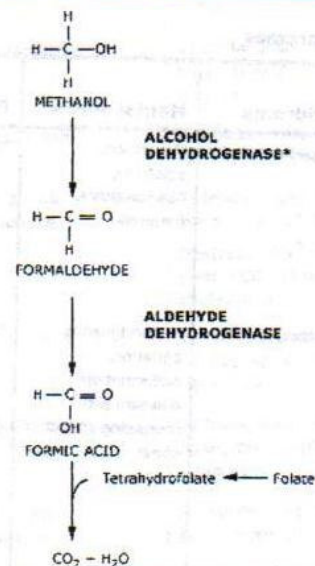
Odor	Agent(s)
Acetone (fruity)	Ethanol, isopropyl alcohol, chloroform, salicylates
Bitter almonds	Cyanide
Garlic	Arsenic, organophosphates, phosphorus, thallium, selenium
Mothballs	Naphthalene, paradichlorobenzene
Kerosene (petroleum distillate)	Organophosphates, parathion
Freshly mown hay	Phosgene
Rotten eggs	Hydrogen sulfide
Wintergreen	Methyl salicylate

## Ethylene glycol metabolism



\* Blocked by ethanol and fomepizole.

## Methanol metabolism



\* Blocked by ethanol and fomepizole.

## Overview of carbon monoxide poisoning

### History

Duration and mechanism of exposure

Assess for major symptoms: loss of consciousness, confusion, symptoms consistent with hypoxia (ie, chest pain)

Assess for minor symptoms: headache, nausea/vomiting

Assess pregnancy status

### Physical examination

Careful evaluation of mental status

Physical examination usually unremarkable

### Diagnostic evaluation

Check CO level via co-oximetry of arterial or venous blood

Check acid-base status on (preferably arterial) blood gas

Check ECG in all patients; check cardiac enzymes in patients  $\geq 65$ , patients with significant cardiac risk factors, and younger patients with chest pain or symptoms suggestive of ischemia

Consider CNS imaging in patients with altered mental status to rule out other etiologies

Check cyanide level and consider empiric treatment in patients with smoke inhalation injury

### Treatment

Secure airway, breathing, and circulation

Intubate as clinically indicated

Apply high-flow oxygen to all CO poisoned patients regardless of pulse oximetry or arterial pO<sub>2</sub>

Direct fire department to assess for environmental exposure and remove victims

We suggest hyperbaric oxygen (HBO) for:

CO level  $>25$  percent ( $>20$  percent if pregnant)

Loss of consciousness

Severe metabolic acidosis (pH  $<7.1$ )

Concern for end-organ ischemia (chest pain, ECG changes, altered mental status)

## Toxidromes

Toxidrome	Mental status	Pupils	Vital signs	Other manifestations	Examples of toxic agents
Sympathomimetic	Hyperalert, agitation, hallucinations, paranoia	Mydriasis	Hyperthermia, tachycardia, hypertension, widened pulse pressure, tachypnea, hyperpnea	Diaphoresis, tremors, hyperreflexia, seizures	Cocaine, amphetamines, ephedrine, pseudoephedrine, phenylpropanolamine, theophylline, caffeine
Anticholinergic	Hypervigilance, agitation, hallucinations, delirium with mumbling speech, coma	Mydriasis	Hyperthermia, tachycardia, hypertension, tachypnea	Dry flushed skin, dry mucous membranes, decreased bowel sounds, urinary retention, myoclonus, choreoathetosis, picking behavior, seizures (rare)	Antihistamines, tricyclic antidepressants, cyclobenzaprine, orphenadrine, antiparkinson agents, antispasmodics, phenothiazines, atropine, scopolamine, belladonna alkaloids (eg, Jimson Weed)
Hallucinogenic	Hallucinations, perceptual distortions, depersonalization, synesthesia, agitation	Mydriasis (usually)	Hyperthermia, tachycardia, hypertension, tachypnea	Nystagmus	Phencyclidine, LSD, mescaline, psilocybin, designer amphetamines (eg, MDMA, MDEA)
Opioid	CNS depression, coma	Miosis	Hypothermia, bradycardia, hypotension, hypopnea, bradypnea	Hyporeflexia, pulmonary edema, needle marks	Opiates (eg, heroin, morphine, methadone, oxycodone, hydromorphone), diphenoxylate
Sedative-hypnotic	CNS depression, confusion, stupor, coma	Miosis (usually)	Hypothermia, bradycardia, hypotension, hypopnea, bradypnea	Hyporeflexia	Benzodiazepines, barbiturates, carisoprodol, meprobamate, glutethimide, alcohols, zolpidem
Cholinergic	Confusion, coma	Miosis	Bradycardia, hypertension or hypotension, tachypnea or bradypnea	Salivation, urinary and fecal incontinence, diarrhea, emesis, diaphoresis, lacrimation, GI cramps, bronchoconstriction, muscle fasciculations and weakness, seizures	Organophosphate and carbamate insecticides, nerve agents, nicotine, pilocarpine, physostigmine, edrophonium, bethanechol, urecholine
Serotonin syndrome	Confusion, agitation, coma	Mydriasis	Hyperthermia, tachycardia, hypertension, tachypnea	Tremor, myoclonus, hyperreflexia, clonus, diaphoresis, flushing, trismus, rigidity, diarrhea	MAOIs alone or with: SSRIs, meperidine, dextromethorphan, TCAs, L-tryptophan
Tricyclic antidepressant	Confusion, agitation, coma	Mydriasis	Hyperthermia, tachycardia, hypertension then hypotension, hypopnea	Seizures, myoclonus, choreoathetosis, cardiac arrhythmias and conduction disturbances	Amitriptyline, nortriptyline, imipramine, clomipramine, desipramine, doxepin