Taming the Toxins: Solutions for Ingestions and Exposures

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Disclosures

I have nothing to disclose.

Objectives

At the completion of this presentation, the participant will be able to:

- Identify common toxins and applicable reversal agents in select toxic ingestions and exposures.
- Recall indications for high dose naloxone and insulin and intralipid therapy in select toxic emergencies.
- Discuss appropriate ordering, monitoring, and risk assessment associated with reversal agents.

Which of the following urinary findings would be associated with an ethylene glycol ingestion?

A. Red discoloration
B. Blue urine
C. Calcium oxalate crystals
D. Hematuria

A family has presented with complaints of symmetrical muscle weakness, which begin in the upper body and now has descended to their legs. They also complain of drooling and dysphagia. You suspect:

A. Nerve gas exposure
B. Botulism poisoning
C. Heavy metal poisoning
D. Carbon monoxide exposure

An elderly patient complains of arthritis pain and tinnitus. The patient has been taking nonprescription medications for pain relief. Based on the patient's chief complaints, the NP should ask about the use of:

A. Ibuprofen (Motrin)
B. Acetaminophen (Tylenol)
C. Naproxen (Aleve)
D. Aspirin

A patient presents who reportedly ingested an unknown amount of acetaminophen. At what time frame should the first acetaminophen level be drawn, ideally?

A. Upon arrival
B. 2 hours after arrival
C. 6 hours after ingestion
D. 4 hours after ingestion

General Management

Decontamination

GI Decontamination

- Induce emesis
- GI lavage
- Whole bowel irrigation

Hemodialysis

Activated Charcoal (AC) - 1 gm/kg PO

Prevents Absorption of Most Ingestants

When Not to Use, Not Effective:

- **P** Pesticides
- **H** Hydrocarbons
- **A** Alcohol, acids, alkali
- **I** Iron preparations
- **L** Lithium
- **S** Solvents

General Toxidromes

Anticholinergics

Cholinergics

Sympathomimetics

Opioids

Cardiotoxics

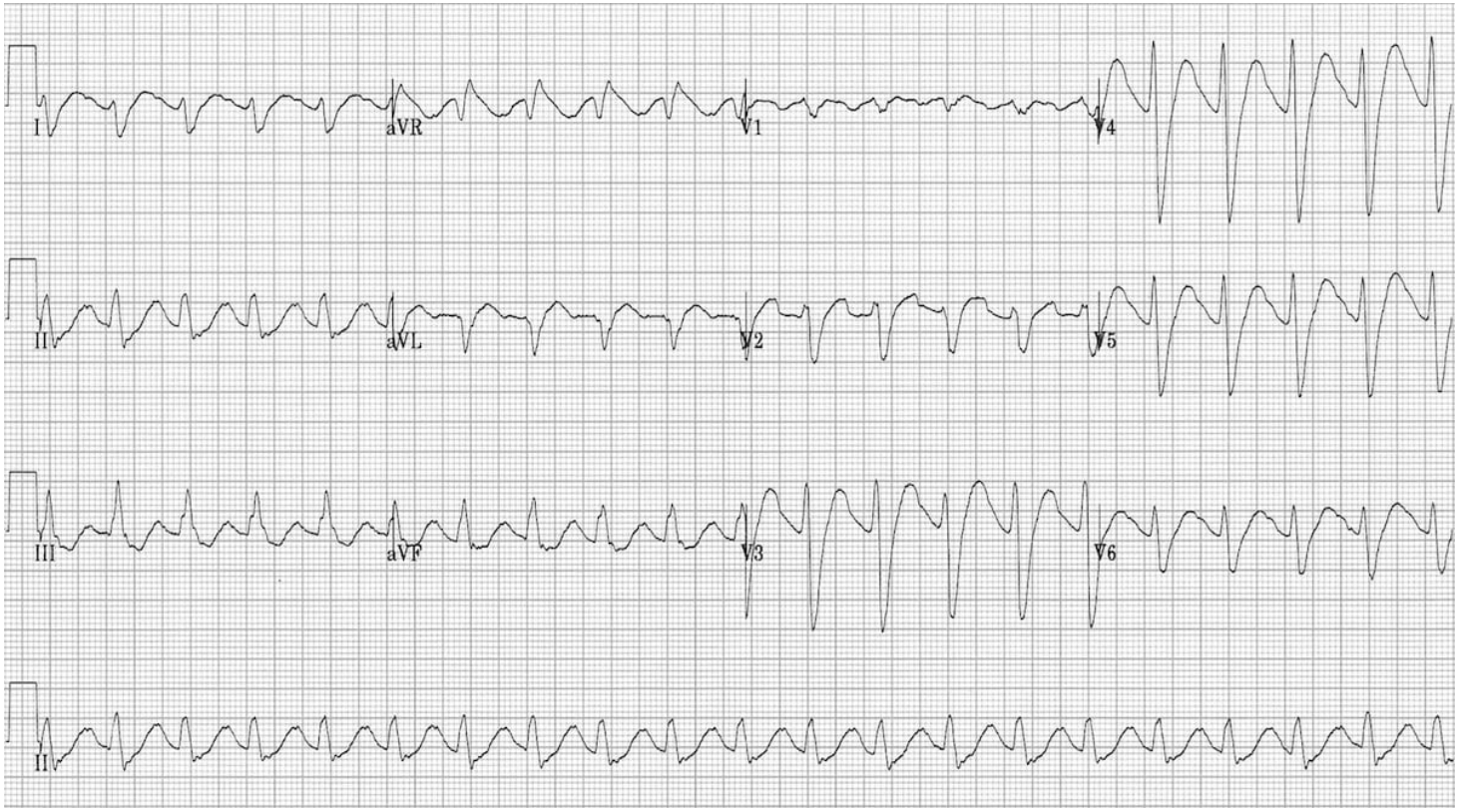
Sedative/Hypnotics

Key points:

- Manage ABC's
- AMS = check glucose
- Hyperactivity, Tachycardia, Hypertension, & Seizures = Benzodiazepines

Case

- 2 y/o patient with unknown ingestion & seizures
- V/S: 68/40, 150, 28, 98%, 102°F
- Dilated pupils
- Differentials
- What else do you want?



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Anticholinergics

Blind as a bat

Red as a beet

Dry as a bone

Mad as a hatter

Hotter than hades

Sick like a seizure

Management

ABC's
- Intubation is common
- Consider controlled hyperventilation

Activated charcoal
- EARLY < 2 hrs
- Only once airway is secured/patent

Benzodiazepines for seizures

Correct hypotension
- Fluid boluses
- Norepinephrine

Systemic alkalization
- Goal pH 7.5-7.55
- $NaHCO_3$ 1 mEq/kg IV bolus
- $NaHCO_3$ Infusion (3 amps in 1L D5W)

A patient presents with a history of pesticide ingestion. Which of the following signs and symptoms should you anticipate?

A. Diarrhea, excessive salivation, vomiting, urinary incontinence

B. Hot flushed skin, agitation, dilated pupils, dry mucus membranes

C. Dizziness, headache, nausea & vomiting, red mucus membranes

D. Hallucination, tachycardia, loss of control over sensory input

Organophosphates

Insecticides, Pesticides, Nerve Agents

Muscarinic Effects: SLUDGEM

- Salivation, lacrimation, urination, defecation, GI, expectoration/emesis, miosis

Nicotinic Effects

- Tremors, respiratory paralysis, hypertension, tachycardia, mydriasis, AMS

Organophosphates

Management

- Decontamination, use PPE
- ABC's - Elevate HOB
- Benzodiazepines for seizures
- Atropine – 2-5 mg IV every 5-10 minutes
  - Peds 0.02 mg/kg IV
- Pralidoxime (2-PAM) – 2 gm IV
  - Peds 20-50 mg/kg initial IV dose
  - Followed by 24 hr infusion

Sympathomimetics

You are managing an adult male with chest pain. His friends inform you that they think he has overdosed on cocaine. Which signs & symptoms of abuse would you expect to detect during the assessment?

A. Lethargy and obtunded state
B. Constricted pupils
C. Hypothermia and tiredness
D. Euphoria and restlessness

Assessment Findings

Mood changes: euphoria, decreased fatigue, increased energy, agitation, paranoia, mania, anxiety

Cardiac: tachycardia, hypertension, cardiac dysrhythmias, coronary artery spasm, QT prolongation

Tremors/Seizures

Hyperthermia

Teeth clenching

Mydriasis

N/V/D

Rhabdomyolysis

Piloerection

Sympathomimetic Mnemonic

Mydriasis

Agitation, Arrhythmia, Angina

Tachycardia

Hypertension, Hyperthermia

Seizure, Sweating

Which of the following medications would be contraindicated in the management of a patient with a methamphetamine associated hypertensive crisis?

A. Diazepam (Valium)
B. Lorazepam (Ativan)
C. Nitroglycerin
D. Metoprolol (Lopressor)

Management

Activated charcoal or whole bowel irrigation for body packers

BENZODIAZEPINES

Rehydration

Monitor for cardiac dysrhythmias

$NaHCO_3$ for QRS prolongation

Nitroglycerin or nitroprusside for severe HTN

Avoid pure beta blockers

Cooling measures

Case

EMS arrives with an 8 y/o unresponsive with agonal respirations

Differentials

Hx: ADHD, Asthma

Home Meds: clonidine, montelukast, albuterol MDI

Treatment

Naloxone (Narcan)

Competitively binds to opioid receptors

- Mu (μ) > kappa (κ) and delta (δ)

Highly lipophilic, distribution t½ of ~4.5 mins, effects are seen within 2 mins

Average duration of effect is 30-90 mins

Administration

- Bolus vs. Continuous Infusion
- Adults: 0.4-1 mg IV/IM/SQ
  - 1 mg IN each nostril
- Peds 0.01 mg/kg IV/IM/SQ/IN
- Auto injector

Naloxone - ROC LAVA X

R – Reserpine

O – Opioids

C – Clonidine

Dose is 10 mg, except with opioids

Infusion at 5-10 mg/hr

L – diphenoxylate-atropine (Lomotil)

A – ACE-Is & ARBs

V – Valproic acid

A – methyldopa (Aldomet)

X – tizanidine (zanafleX)

Only FDA approved for opioid reversal

Xylazine, aka “Tranq”

Presynaptic alpha-2 adrenergic agonist – like dexmedetomidine

Only approved in veterinary medicine

Often added to illicit fentanyl, heroin, and stimulants

Toxicity and withdrawals may mimic opioids

May respond to higher doses of naloxone

Can cause significant tissue destruction

Causes of Miosis

Opioids

Central alpha 2 agonists

Organophosphates

Phencyclidine

Sedative hypnotics

Phenothiazines

Nicotine

Pilocarpine ophth. gtts

Olanzapine (Zyprexa)

Pontine hemorrhage

commons.wikimedia.org/wiki/File:Myosis_due_to_opiate_use.jpg (CC0 1.0)

Case Scenario

60 y/o patient w/ AMS, hypotension, bradycardia

Differentials

Home Medications

- Metoprolol, diltiazem, atorvastatin, aspirin

What can help differentiate between the two?

Management

Traditional Management

IV fluids

IV calcium

Inotropes/Chronotropes

Vasopressors

Pacing

What if there is NO improvement with these interventions?

Glucagon

Glucagon & β-receptors linked to adenyl cyclase enzyme

- + inotrope and chronotrope
- ↑ intracellular cAMP levels and ↑ calcium influx
- Stimulates endogenous catecholamine release

Dose

- 5 mg slow IV bolus; Peds: 50 mcg/kg
- Infusion 2-5 mg/hr; Peds: 70 mcg/kg/hr
- Prepare for N/V, especially if given too fast
  - Ondansetron

High Dose Insulin (HDI) Therapy

aka Hyperinsulinemia-euglycemia (HIE)

- 1 unit/kg bolus
- 0.5-1 unit/kg/hr & titrate
- D10 or higher infusion

↑ calcium and glucose entry into cells

↑ endothelial nitric oxide (NO) synthase activity

Monitor potassium and glucose closely

Be prepared to titrate down other agents

IV Lipid Emulsion (ILE) Therapy

20% intralipid bolus and infusion (not FDA approved)

- 1-1.5 ml/kg bolus, repeat in 5 mins if needed
- 0.25-0.5 ml/kg/min infusion till stable
- Max dose ~10ml/kg

"Lipid Sink Theory"

- Creates lipid compartment & pulls lipophilic meds out of cells

+ inotropic effect

- Fatty acid uptake = energy
- ↑ calcium uptake = stronger contractions

A patient presents with refractory seizures and an anion gap metabolic acidosis after exposure of an unknown substance. Which of the following toxins is most likely responsible?

A. Ethylene glycol
B. Benzodiazepines
C. Carbon monoxide
D. Methadone

Treatment for a methanol ingestion may include

A. Ethanol PO
B. Activated charcoal PO
C. Naloxone (Narcan) IV
D. Flumazenil (Romazicon) IV

Gap Acidosis

Detects unmeasured anions in the plasma to help identify the cause of a metabolic acidosis

- Lactate, phosphate, sulfates, proteins, and organic anions

To Calculate: Na^+ (+/- K^+) - (HCO_3^- + Cl^-)

Normal Range: 12 +/- 4 mEq/L

A non-gap acidosis results from a loss of HCO_3^- or a gain of H^+

Causes of a Gap Acidosis

Methanol

Uremia

DKA

Propylene Glycol

INH, **I**ron, **I**nhalants

Lactic Acidosis

Ethylene Glycol

Salicylates

Alcohols

Toxic Alcohols

- Ethylene glycol (antifreeze) → oxalic acid
  - Calcium oxalate crystal formation→ renal failure, lactic (metabolic) acidosis, mental status changes
- Methanol (wood alcohol) → formic acid
  - Mental status changes, vision changes including blindness, GI upset, lactic (metabolic) acidosis

Isopropanol (isopropyl alcohol, rubbing alcohol)

- CNS depression, dizziness, poor coordination, GI upset, gastritis, acetone breath

Management

Isopropanol = supportive care

Ethylene glycol & methanol

- Fomepizol (Antizol) – best within 4 hrs
- Ethanol 10% infusion or PO, if fomepizole is not available
  - Not FDA approved
- Sodium Bicarb Infusion to treat acidosis
- Thiamine and pyridoxine for ethylene glycol
- Folinic or folic acid for methanol
- Hemodialysis

Cyanide Poisoning

Comes from the burning of wool, silk, plastics, polyurethane; used with precious metal mining and refining

Cellular Effects

- No oxidative phosphorylation
- No Krebs cycle
- Causes anaerobic metabolism → lactic acidosis
- Cellular asphyxia despite adequate arterial oxygen

Cyanide Poisoning

Clinical Presentation

- AMS
- Dizziness
- Headache
- Tachycardia
- Tachypnea

Laboratory Findings

- Elevated cyanide level
- Metabolic lactic acidosis

Levels

- 0.5-1 mg/L – flushing
- 1-2.5 mg/L – AMS
- 2.5-3 mg/L – coma
- > 3 mg/L – death

Cyanide Management

Intubate Early

Cyanide Kit (CAK)

- No longer manufactured

Hydroxocobalamin (Cyanokit)

- 5 gms chelates 100 mg of cyanide
- Forms cyanocobalamin and is excreted in the urine
- If no improvement noted within 15 mins, need to repeat
- May cause red-orange discoloration of skin and urine

Which finding on a venous blood gas is most consistent with carbon monoxide poisoning?

A. Normal PO_2 with decreased SpO_2
B. Decreased PO_2 with elevated bicarbonate
C. Decreased pH with normal SpO_2
D. Elevated PCO_2 with reduced lactate

Carbon Monoxide (CO)

Odorless, colorless, tasteless gas

Produced by combustion of organic materials

Higher affinity for Hgb than O_2 (>200x)

Causes severe tissue hypoxia

Carbon Monoxide

Acute exposure

- Headache (85% pts)
- Dizziness (90% pts)
- Decreasing LOC
- Bradycardia
- Dysrhythmias
- Nausea & Vomiting
- Seizures or twitching
- Cherry red color to skin (RARE)

Chronic exposure

- Symptoms are severe upon awaking; improvement after leaving the source
- Dizziness
- Recurring headaches
- Nausea

Carbon Monoxide Poisoning

CoHB Level	Symptoms
5-10%	Asymptomatic, mild HA, vertigo
10-20%	HA, N/V, loss of coordination, flushed skin
20-30%	Confusion, lethargy, ST depression, visual disturbances
40-60%	Coma, seizures

CO Poisoning Management

ABC's - 100% O_2 via mask or ETT

CO-oximeter (SpCO)

Hyperbaric oxygen (HBO) therapy

Complications

- ARDS
- Rhabdomyolysis
- Lactic Acidosis
- Delayed Neuro Sequela
  - Cognitive defects
  - Parkinsonian like syndromes

Salicylates

"Uncouples" oxidative phosphorylation

Decreases platelet function

Inhibits vitamin K dependent clotting factors

Peak serum levels occur 2-6 hours after acute ingestion (6-9 hours for enteric coated)

Toxic dose to produce symptoms is 150-300 mg/kg

- > 500 mg/kg is considered lethal

Poisoning Symptoms

Tinnitus

Nausea & Vomiting

Hyperventilation

Impaired hearing

Diaphoresis

Respiratory alkalosis

Metabolic acidosis

Mental status changes

Noncardiogenic pulmonary edema (ARDS)

Hyperthermia

Management

Airway considerations

Obtain serum salicylate level on arrival and 6 hours after ingestion

Charcoal if within 3 hrs of ingestion

Fluid administration to support perfusion

Urine alkalinization (3 amps in 1L D5W)

Monitor for hypoglycemia and hypokalemia, and hematuria

Hemodialysis for severe ingestions

Acetaminophen (APAP) Poisoning

Toxicity produces delayed hepatic necrosis

Serum levels 140 mg/kg are toxic

Signs and symptoms develop slowly

- Phase I
  - 0-24 hours after ingestion
  - Malaise, diaphoresis, mild gastric upset (N/V), anorexia

Acetaminophen Poisoning

- Phase II
  - 24-48 hours post ingestion
  - Right upper quadrant pain, ↓ urine output, ↑ LFT's & PTT, hepatomegaly
  - AST is most sensitive
- Phase III
  - 72-96 hours post ingestion
  - Massive hepatic dysfunction, jaundice, hypoglycemia, N/V, RUQ pain, coagulopathies (DIC), metabolic acidosis
- Phase IV
  - 4 days to 2 weeks
  - Resolution of LFT's and symptoms or death

Management

Obtain 1st blood level 4 hrs after ingestion

Activated charcoal if ingestion ≤ 4 hrs

N-acetylcysteine (NAC, Mucomyst)

- Analogue of glutathione
- Best within 8 hr of ingestion
  - Has limited benefit after 24 hrs
- Acetadote – IV formulation

Case

30 y/o patient presents w/ agitation

V/S: 120, 160/90, 28, 99%, T 102° F

Hx: Depression

Meds: Sertraline (Zoloft)

- St. John's Wort

Differentials

Plan of Care

Serotonin Syndrome

Mild-Moderate Serotonin Syndrome

- Hypertension
- Tachycardia
- Hyperthermia
- AMS

Cyproheptadine (Periactin)

- Histamine and serotonin receptor antagonist

Dose: 8 mg PO every 8 hrs x 24 hrs

See benefit within 1-2 hours

Severe Serotonin Syndrome

- Intubation and paralysis
- Benzodiazepines
- Cooling Techniques

Which of these medicines would you expect to give to a patient who ingested a sulfonylurea and has refractory hypoglycemia?

A. Intralipid emulsion therapy
B. Sodium bicarbonate
C. Octreotide (Sandostatin)
D. Glycopyrrolate (Robinul)

Anticoagulation Reversal Agents

Heparin: protamine

Warfarin: vitamin K +/- FFP or 4F-PCC (Kcentra & Balfaxar)

Dabigatran: idarucizumab (Praxbind)

Rivaroxaban & apixaban: andexanet alfa (Andexxa)

- Use with edoxaban is off label

4F-PCC may be an option for all DOACs (off label)

Reversal Agents

Benzodiazepines: airway management +/- flumazenil (Romazicon)

Heavy Metals: Chelating agents

Extravasation of a vasopressor: phentolamine

Summary

Consult Toxicology – Poison Control

- 1-800-222-1222

Activated Charcoal within 2-4 hours of most ingestions

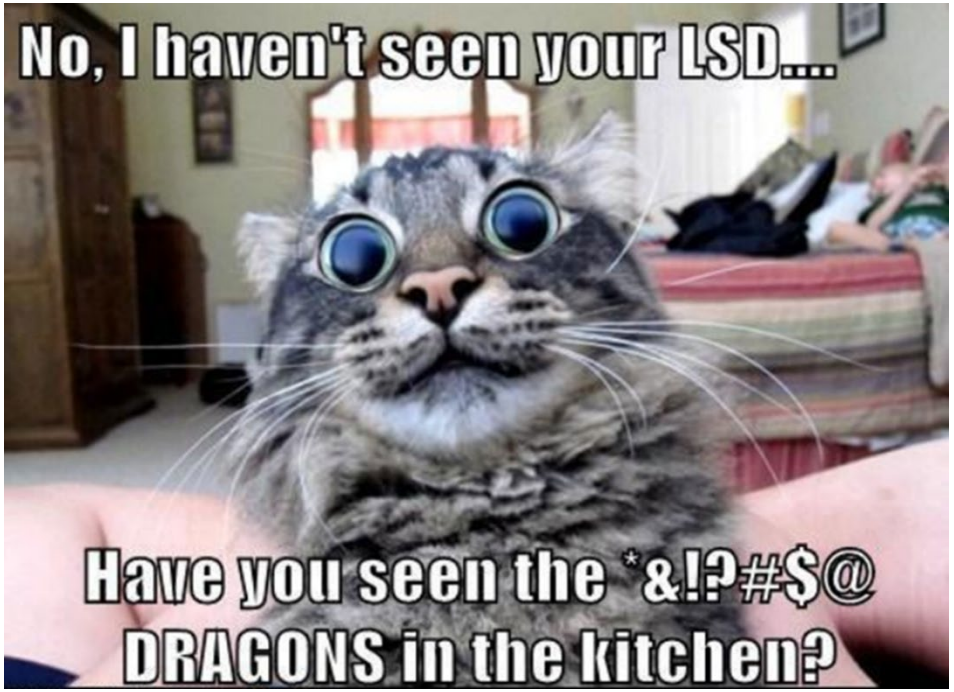
- What about their mental status and airway?

Whole bowel irrigation for extended-release medications and iron

Check a glucose, a temperature, & obtain a 12 lead ECG

Questions

Contact Info



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