

Approach to Toxicology

Terminology:

- **Toxidrome** = Combination of signs and symptoms that suggest specific CLASS of toxin
 - 4 main types:
 - Sympathomimetic
 - Opioid
 - Anticholinergic
 - Cholinergic
 - Look for vital signs & physical findings

1. GENERAL APPROACH - The Poisoned Patient:

- 2 components → Treatment & Diagnosis (occurring simultaneously)
- TREATMENT:
 - Airway → possible intervention if ↓GCS
 - Breathing → ensure proper ventilation & oxygenation = supplemental O2 if hypoxic
 - Circulation → IVF to maintain end organ perfusion + cardiac monitor + ECG
 - D.O.N.T./Decontamination
 - **Dextrose**: many toxins cause hypoglycemia → bedside BG test for everyone
 - If ↓BG → IV dextrose
 - **O2** → if hypoxic
 - **Naloxone** → for suspected opioid toxidrome with resp depression
 - **Thiamine** → for chronic alcoholics with suspected Wernicke's encephalopathy (rare)
 - Decontamination:
 - Skin → if toxin on skin/clothes then remove and irrigate skin copiously with water
 - Gloves, goggles, gowns for care providers to prevent contamination
 - Eyes → irrigation if involved
 - GI → if toxin ingested
 - **Activated charcoal** → for presentation **1-2h** post ingestion
 - Will bind to toxin in stomach → excretion
 - Disadvantages:
 - Not effective for liquids, metals
 - Aspiration risk with ↓GCS
 - Whole bowel irrigation → for specific toxins that don't bind to charcoal
 - ++Fluids to flush out contents of bowel
 - Enhanced elimination → once toxin in circulation
 - Dialysis → used for ASA, Digoxin, toxic alcohols
 - **Focused** therapy = specific antidotes (see below for more info):
 - Acetaminophen, ASA, toxic alcohols, etc.
 - Get toxicology help → poison control centre
 - Early involvement important
 - DIAGNOSIS:
 - Hx → often difficult to obtain from intoxicated patient, use collateral
 - **What** was taken
 - Ask about all available meds in house (OTC, herbal)
 - Have family members go through all meds at home and bring empty bottles
 - Ask EMS about bottles found at the scene
 - **When** it was taken
 - How **Many**
 - **Why** → intentional vs accidental
 - Px + Toxidrome recognition (see below)
 - VITALS → Temp, HR, BP, RR, O2 sat
 - NEURO → toxins produce global ↓LOC, possible seizures
 - Key points = global motor/sensory exam, pupils (size)
 - SKIN → dry vs wet (diaphoretic)
 - Look for drug patches (ie. nitro, fentanyl)
 - Diagnostic Tests

- **Blood Gas** → many toxins cause metabolic acidosis
 - Obtain venous gas (arterial not required)
- **Anion Gap** → $AG = Na - (Cl + HCO_3) \rightarrow \text{normal} = 12$
 - Causes of ↑AG → MUDPILES CT
 - Methanol, metformin
 - Uremia
 - DKA
 - Paraldehyde
 - Iron, Isoniazid
 - Lactate
 - Ethylene glycol
 - Salicylates
 - CO, CN
 - Toluene
- **Osmol Gap** (absolute value) = expected osmolality – measured serum osmolality → >10 = abnormal
 - Expected = $2Na + \text{Glucose} + \text{BUN}$ (“2 salts and a sugary bun”)
 - Causes of ↑OG:
 - Ethanol
 - Ethylene Glycol
 - Methanol, mannitol
- Specific **Drug Levels** (QUANTITATIVE) → available for:
 - Acetaminophen, ASA, Digoxin, anti-seizure, alcohols (incl toxic alcohol)
- **Drug Screen** (QUALITATIVE)
 - Disadvantages = cross-reaction, timely (not helpful in acute settings)
 - Therefore rarely used in ED
- Xray:
 - Packets, heavy metals → AXR
 - Resp difficulty → CXR

2. MAIN TOXIDROMES:

- SYMPATHOMIMETIC Toxidrome:
 - Stimulants = amphetamines, cocaine
 - Presentation
 - Vital signs → ↑
 - ↑HR, ↑BP, ↑temp, ↑LOC (agitated)
 - Pupils = **dilated**
 - Skin = flushed, warm, WET (diaphoretic)
 - Tx:
 - **Supportive** care → treat symptoms
 - Cooling for ↑temp
 - BZDs (lorazepam, diazepam) for agitation, seizures
- OPIOID Toxidrome:
 - Examples = morphine, fentanyl, methadone, heroin
 - Presentation:
 - Vital signs → ↓
 - ↓HR, ↓BP, ↓temp, ↓RR, ↓LOC (difficult to rouse)
 - Pupils = **constricted**
 - Death = by hypoxia 2° to ↓RR
 - Tx:
 - If ↓RR or ↓O₂ sat → give **naloxone** (opioid antagonist)
 - IVF if hypotensive
- ANTICHOLINERGIC Toxidrome:
 - Examples = TCA, diphenhydramine, dimenhydrinate
 - Presentation:
 - Vital signs → ↑
 - ↑HR, ↑BP, ↑temp, ↑LOC (agitation/confusion)

- Pupils = **dilated**
- Skin = flushed, warm, DRY
- Urinary retention
- Tx:
 - **Supportive** care (except TCA – discussed below)
 - IVF + Cooling for **↑temp**
 - BZDs (lorazepam, diazepam) for agitation, seizures
- CHOLINERGIC Toxidrome:
 - Examples = organophosphates (pesticides, insecticides)
 - Presentation = opposite to anticholinergic
 - **↑Secretions** (salivation, lacrimation, urination, diarrhea, GI emesis/vomiting)
 - Vital signs:
 - **↓↓HR**
 - Pupils = **constricted**
 - Tx:
 - **Atropine** → **↑HR** + **↓secretions**
 - +/- Pralidoxime = specific cholinergic antidote

3. SPECIFIC TREATMENTS – see above for tx of specific toxidromes

- ACETAMINOPHEN toxicity:
 - Targets LIVER → hepatocellular damage, necrosis, liver failure
 - Toxic dose = **150mg/kg**
 - 4 stages:
 - 1 = nonspecific → nausea, vomiting
 - 2 = beginning of liver involvement → RUQ pain, **↑AST**, **↑ALT**
 - 3 = when patient sickest → fulminant hepatic failure
 - Coagulopathy, lactate acidosis, encephalopathy
 - 4 = gradual recover (for those surviving stage 3)
 - Diagnosis:
 - Hx → when, how much (>150mg/kg)
 - Lab:
 - AST, ALT, INR
 - Serum acetaminophen level → **Rumack-Matthew Nomogram**
 - Plots serum level vs time of ingestion → determines hepatic toxicity
 - If probable hepatic toxicity → treat with antidote
 - Tx with specific antidote = **N-Acetyl Cysteine (NAC)**
 - Can be given PO vs IV (IV preferred in Canada)
- ASA toxicity:
 - Toxic dose = **300mg/kg**
 - Presentation → 3 targeted systems
 - NEURO → tinnitus, lethargy, confusion, seizures
 - GI → N/V
 - RESP → hyperventilation, resp distress
 - Diagnosis:
 - Hx → when, how much
 - Labs:
 - Routine BW to determine dehydration
 - ASA Level
 - Blood gas → AG metabolic acidosis
 - Will have **↓↓pCO2** → from metabolic acidosis + effect of ASA on respiration → also get respiratory alkalosis from overcompensation (**↑pH**)
 - Treatment:
 - Supportive → ABCs
 - Specific = ALKALINIZATION → **IV NaHCO3**
 - ASA elimination = renal → **↑clearance** with **↑urine pH**
 - **↑urine pH** via blood alkalinisation
 - Give NaHCO3 then test urine pH → titrate to **>7.5**

- Hemodialysis → if patient looking sicker post alkalinisation treatment
 - Severe acid-base imbalance
 - ↑Neuro deficits → seizure, cerebral edema
 - Resp deterioration
- TCA toxicity:
 - Examples = Amitriptyline, Imipramine
 - Main Targets:
 - NEURO → ↓LOC, seizures
 - CVS → ↑HR, ↓BP, arrhythmia
 - Diagnosis:
 - Hx → when, how much
 - Labs:
 - Routine BW +/- suspected co-ingestant levels (ASA, tylenol)
 - No test for serum TCA serum level
 - ECG (more valuable than labs) → abnormalities ↑ with severity of OD
 - ↑HR
 - AV block
 - Wide QRS → risk of arrhythmias +/- seizures
 - ↑QT → risk of arrhythmias
 - Treatment:
 - Supportive → ABCs
 - Specific → **NaHCO₃**
 - Indication = Wide QRS, arrhythmia, hypotension post IVF
 - BZD → for seizures
- TOXIC ALCOHOL Toxicity
 - **Methanol & Ethylene Glycol** → parent compounds (ie. alcohol) not toxic & cause ↑serum Osmol
 - Metabolized to **acids** = TOXIC (no effect on serum osmol, but cause AG metabolic acidosis)
 - Methanol → metabolized to formic acid (toxic)
 - Targets:
 - EYES → blindness via optic nerve
 - NEURO → ↓LOC, ataxia, seizures
 - Ethylene Glycol → metabolized to oxalic acid (toxic)
 - Targets = KIDNEYS
 - Diagnosis:
 - Hx → when, how much (try to obtain original container)
 - Px:
 - VS → ↑RR from metabolic acidosis
 - ↓visual acuity, ↓LOC +/- seizures
 - Labs:
 - Routine BW
 - Serum osmolality + Blood gas
 - Serum toxic alcohol levels (ie. fractioned alcohol level)
 - Compare level with osmol gap
 - Treatment:
 - Goal = BLOCK metabolism via enzyme responsible (alcohol dehydrogenase)
 - **Ethanol** infusion → binds to enzyme, blocking other alcohol metabolism
 - **Fomepizole** → deactivates enzyme
 - REMOVE metabolites → hemodialysis
 - Not required if initiation of treatment before conversion to metabolites occurs