Project: Ghana Emergency Medicine Collaborative

Document Title: Basics of Toxicology

Author(s): Patrick Carter, MD, University of Michigan Medical School

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Basics of Toxicology

Medical Student Lecture Series
Emergency Medicine

revised 6/2009

Objectives

- Describe the role of GI decontamination
- Recognize common toxidromes
- Recognize substances for which specific antidotes exist
- Initiate ED management of a patient with an overdose

The undifferentiated patient

- A patient is dropped off at the ED door. He is minimally responsive. His friends say they think he took something and drive off…
- Where do we start?

Approach to (possible) Tox patient

- Simultaneous treatment & diagnosis
- Immediate action:
  - ABC(D) , IV / O2 / monitor
- Thinking:
  - Is this a tox problem?
  - If yes, are there complicating factors?
    - Got drunk and fell down, now with head injury?
  - Resources to get a history?

Approach to (likely) Tox patient

- You've considered a differential and you think it is a toxicologic issue
- Immediate action:
  - Supportive therapy (airway etc)
  - Decontamination
- Thinking:
  - Toxidrome present?
  - What more information do I need?
- Definitive Management
  - Is there an antidote or specific treatment?

Overdose History

- Time of ingestion
- Talk to witnesses
- Get pill bottles & count!
- Assume common co-ingestants
  - Alcohol
  - Acetaminophen
  - Aspirin

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Decontamination

- GI exposure
  - Most common route (75% of toxic exposures)
  - Prevent absorption
- Topical exposures
  - Remove clothing
  - Wash skin
- Enhance elimination
  - Whole bowel irrigation
  - Sorbitol
  - Diuresis / ion trapping
  - Hemodialysis

GI Decontamination

- ***Activated Charcoal***
  - Absorbs up to 60% of ingestant
  - 1 gm/kg +/- Sorbitol
  - Maximal effect if given early (<1 hr)
  - Will not bind – metals, electrolytes, acids
  - Contraindications
    - Depressed MS – Intubate to avoid aspiration
    - Bowel obstruction / perforation
    - Acid/ alkali ingestion

GI Decontamination –

- Rare interventions
  - Gastric lavage
    - Early presentation of potentially lethal OD
      - e.g. tricyclics, iron, CCBs, B-blockers
    - High Risk – aspiration / perforation / airway compromise
  - Syrup of Ipecac – Rarely used now
    - Induces vomiting & eliminates less than charcoal
    - Cardiomyopathy risk
  - Whole bowel irrigation
    - Sustained release preparations
    - Body packers

2 am Toxicology Resources

- Poison Control
  - 1-800-POISON1
- Micromedex
  - General drug info
- Poisindex
  - Overdose management
- Identidex
  - Imprint identification

Parhamr, Wikimedia Commons

Treatment Goals with OD

- ABC's
- Identify (if possible) substances
- Reduce absorption
- Enhance elimination
- Specific antidotes (if possible)
  - Relatively few but important to know
- Supportive care

Classic Toxidromes

Hint for exam:

Know these

- Narcotic
- Sympathomimetic
- Anticholinergic
- Cholinergic

Narcotics

- Natural & synthetic compounds which mimic endogenous endorphins
- Heroin, Morphine, Dilaudid, Demerol, Vicodin, Methadone, Fentanyl (China White), Oxycontin
- Different pharmacologic parameters
- Common drugs of abuse
- Street drugs – adulterated (mixed OD)

Narcotics – Clinical picture

	Temp	HR	RR	Pupils	BS's	Skin
Narcotic	---	↓	↓↓	↓↓	↓↓	---
Sympathomimetic						
Anti-cholinergic						
Cholinergic						

Narcotics - treatment

- Support ABCs
- Narcan 2mg IV q2min until effect
  - Comes in 0.4mg vials!
- Can require massive doses
- IV / IM / SQ / ET routes
- Short acting & may require repeat doses or IV drip

Sympathomimetics

- Fight or flight system
- Drug activate adrenergic nervous system
- Cross-activation of dopaminergic → euphoria & hallucinations

Sympathomimetics – clinical picture

	Temp	HR	RR	Pupils	BS's	Skin
Narcotic	---	↓	↓↓	↓↓	↓↓	---
Sympathomimetic	↑	↑↑	---	↑	---	sweaty
Anti-cholinergic						
Cholinergic						

Common sympathomimetics

- Cocaine
- Caffeine
- Ephedrine
- MDMA (ecstasy)
- LSD (prominent hallucinations)
- Pseudephedrine (Sudafed)

Sympathomimetics - treatment

- ABCs
- Supportive care / time
- Cocaine – avoid B-blockers

Anticholinergic Toxidrome

- Antagonism of the cholinergic nervous system (parasympathetic)
- Sympathetic disinhibition & loss of parasympathetic functions
- Common medication side-effect
- Less commonly abused class of drugs

Anticholinergics - clinical picture

	Temp	HR	RR	Pupils	BS's	Skin
Narcotic	---	↓	↓↓	↓↓	↓↓	---
Sympathomimetic	↑	↑↑	---	↑	---	sweaty
Anti-cholinergic	↑	↑	---	↑	↓↓	dry
Cholinergic						

Anticholinergics

- Blind as a bat (mydriasis)
- Hot as hare (flushed & warm)
- Mad as a hatter (delirium)
- Dry as a bone (membranes & axillae)

- "Can't see, can't pee, can't s—t, can't spit"

Common anticholinergics

- Atropine
- Antihistamines (Benadryl)
- Phenothiazines (antiemetics)
- Tricyclic antidepressants
- Jimsonweed (Datura)

Denniss, Wikimedia Commons

Anticholinergics - Treatment

- ABCs
- Decontamination
- Supportive / time
- Urinary drainage

Cholinergic Toxidrome

- Increased acetylcholine activity
- Nicotinic NS: increased nerve transmission and muscle activation
- Muscarinic NS: liquid management
- Rarely abused
- Occupational exposures - insecticides

Cholinergics – clinical picture

- Nicotinic effects
  - Tachycardia, muscle fasciculations, weakness (nerve transmissions can't get through), respiratory depression, paralysis,miosis
- Muscarinic effects - SLUDGE
  - Salivation
  - Lacrimation
  - Urination
  - Defecation
  - GI upset
  - Emesis

Cholinergics – clinical picture

	Temp	HR	RR	Pupils	BS's	Skin
Narcotic	---	↓	↓↓	↓↓	↓↓	---
Sympathomimetic	↑	↑↑	---	↑	---	sweaty
Anti-cholinergic	↑	↑	---	↑	↓	dry
Cholinergic	---	↓	---	↓	↑↑	sweaty

Common Cholinergics

- Organophosphate insecticides
- Nerve gas (i.e. Sarin, VX)
- Myasthenia Gravis meds
- “Green tobacco sickness”
  - Nicotine poisoning during harvest

Cholinergics - Treatment

- ABCs
- Decontamination
- Atropine 2 mg q 5 minutes until secretions dry (massive doses)
- Pralidoxime (2PAM) if organophosphates
- Supportive care / time

Case 1

- 2 yo M got into older sister's medication. Mother brings to ED stating he's had an allergic reaction
- P145 R25 T100.1 Skin flushed but no urticaria or rash. Seems to be picking at the air. Pupils dilated. Dry diaper.
- Nurses requesting Benadryl for his allergic reaction.
- Is this a good idea? What's going on?

Case 1 cont

- Anticholinergic toxidrome
- Sister's medication → Detrol
  - Anticholinergic
- Benadryl also anticholinergic!

- Treatment?

Case 2

- 15 people from a local government building with vomiting and weakness.
- 2 patients with respiratory distress require intubation. Copious oral secretions are noted.

- What's going on?

Case 2 cont

- Cholinergic toxidrome
  - SLUDGE
- Nerve gas / deliberate exposure
  - 1995 – Sarin in Tokyo subway
- Treatment?

Classic Ingestions

Acetaminophen

Acetaminophen

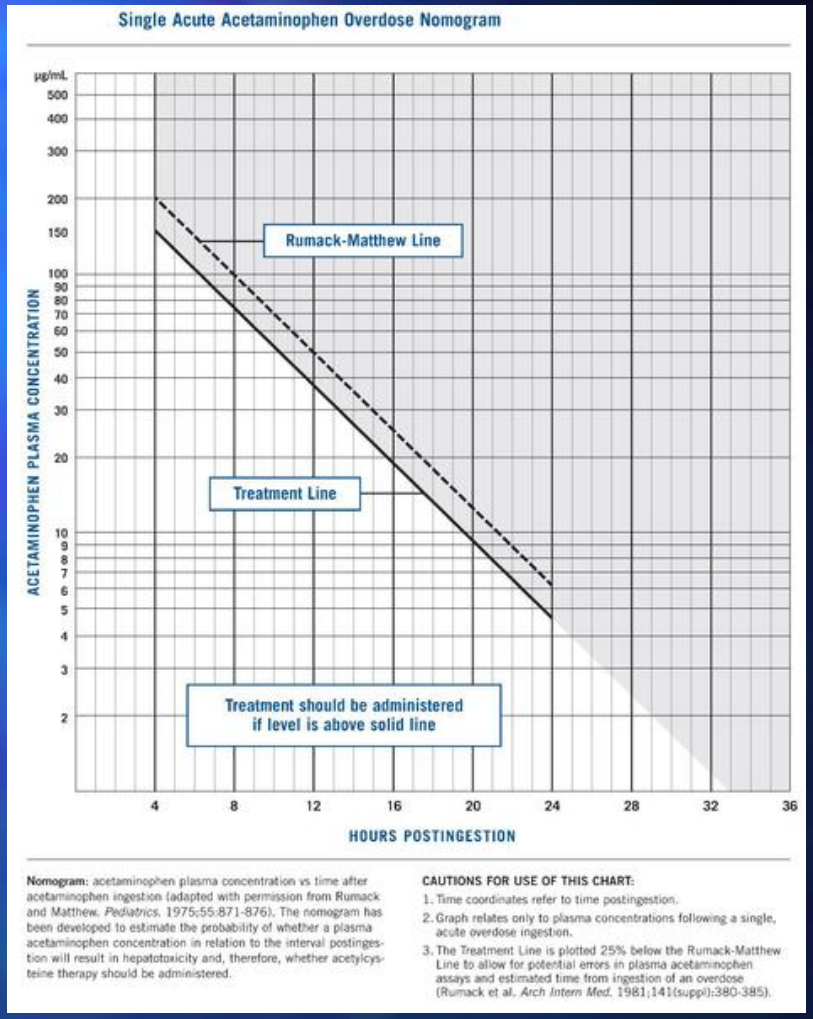
- Common “cry for help”
- Ubiquitous
  - Accidental OD’s – “multi-symptom cold meds”
  - Common co-ingestant
- Initially asymptomatic or mild GI upset
- Quiescent period of a few days after intoxication (LFTs may be elevated)
- Delayed & sometimes fatal liver toxicity

Acetaminophen

- Metabolite toxic to hepatocytes causing hepatic necrosis
- At therapeutic doses, glutathione neutralizes metabolite and prevents toxicity
- At high doses glutathione depleted and toxicity results

Acetaminophen

- Rumack-Matthews Nomogram
- Predicts hepatic toxicity based on level and time of overdose
- Toxic theshold 140 mcg/ml



Melrin Cyrstal, Wikimedia Commons

Specific intoxications: Tylenol

The rule of 140

- Toxic dose is 140 mg/kg
- Toxic level at 4 hours is 140 mcg/ml
- First dose of NAC is 140 mg/kg po (subsequent 17 doses are 70mg/kg)

- If 15 kg child, how many ES Tylenol pills (500 mg each) for toxic level?

Acetaminophen

- Treatment: N-acetylcysteine
- Replenishes glutathione in the liver
- Tastes AWFUL
  - May require NGT administration
  - Newer IV form (Acetadote – 2004)

Salicylates

Salicylates

- ASA, Peptobismol,
- Oil of wintergreen
  - 1 tsp = 7gm salicylate (peds lethal dose)
- Symptoms onset within 1 hour
- Enteric-coated delays absorption
- Gastric bezoars also delay absorption
- Renal clearance

Salicylates

- Symptoms
  - Vomiting, tinnitus, hyperpnea, fever (mild)
  - Acidosis, AMS, seizures and shock (severe)
  - **Metabolic acidosis w/ respiratory alkalosis
- Toxicity begins at 50mg/kg (acute)

Specific intoxications: Salicylates

- General guidelines for severity
  - Mild <300 mg /kg ingested
  - Moderate 300-500 mg/kg
  - Severe / potentially lethal > 500 mg/kg
- Serum level > 30 mg/dl at 6 hrs - toxic
- Done nomogram
  - Historical interest only
  - Serum level not predictive of degree of toxicity

Salicylates - Treatment

- Increased elimination in urine
  - Urine alkalinization
    - 3 amps of bicarb in 1 L of D5W
- Hemodialysis indicated if
  - Coma, seizure
  - Renal, hepatic, or pulmonary failure
  - Pulmonary edema
  - Severe acid-base imbalance
  - Deterioration in condition

Tricyclic Antidepressants

Tricyclic antidepressants

- Depression, sleep, & pain disorders
- Less common due to SSRI prevalence
- High toxicity in overdose

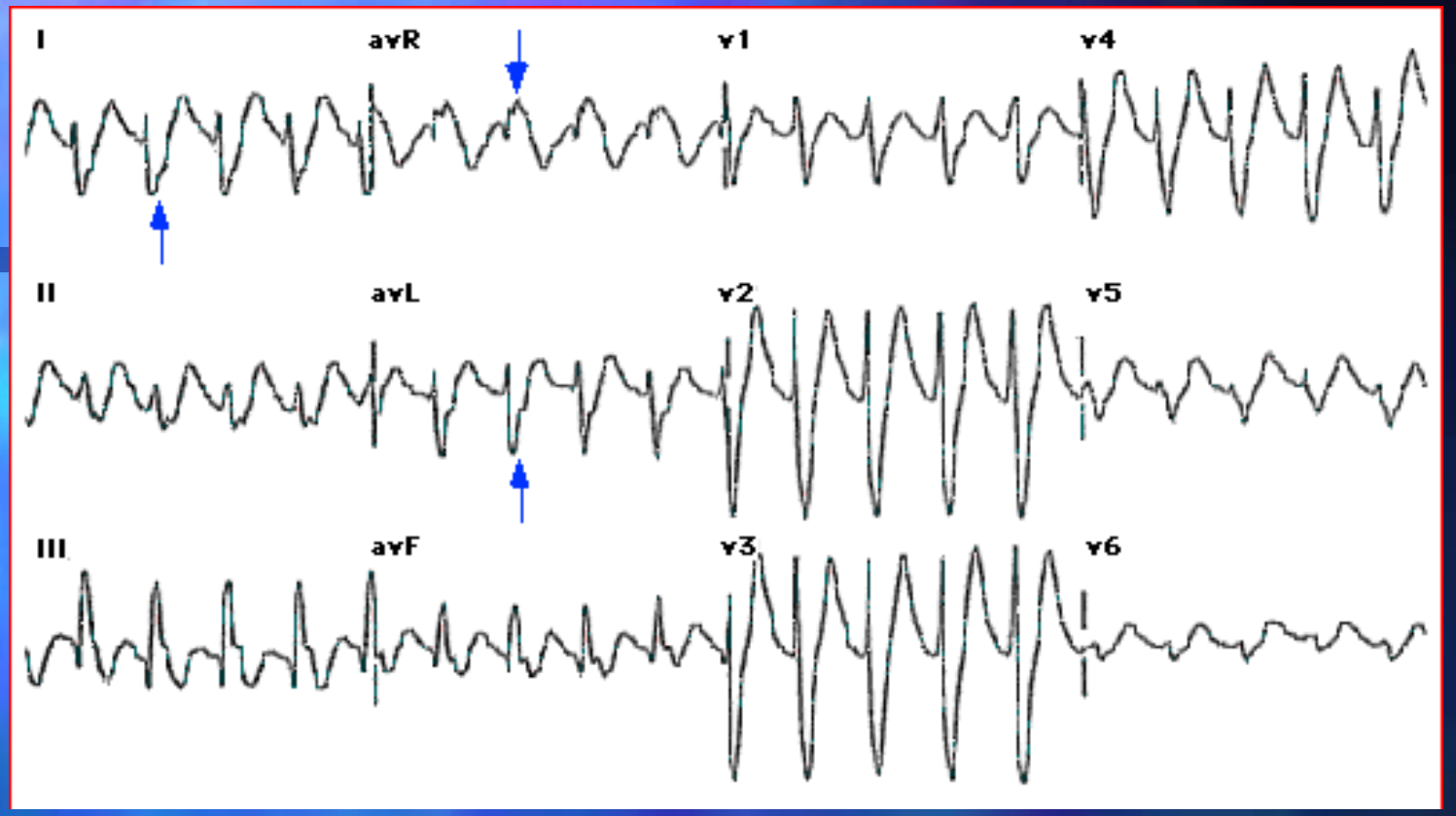
Tricyclic antidepressants

- Anticholinergic toxidrome plus
- Cardiac Dysrhythmias
  - Quinidine-like (Ia) effects on Na channels
  - Sinus tach, Vfib, Vtach
- Seizures

Tricyclic antidepressants

Screening EKG

- Widened QRS
  - > 100ms – sz & dysrhythmia risk
- R wave in aVR and S waves in I, aVL
- Prolonged QTc



PD-INEL Source Undetermined

Electrocardiographic changes associated with tricyclic antidepressant overdose. The QRS complex is prolonged with delayed right ventricular activation and intraventricular conduction delay, which results in rightward shift in the terminal 40 msec frontal plane QRS vector. In qualitative terms, this shift manifests as a deep, slurred S wave in leads I and AVL, and an R wave in lead AVR (blue arrows).

Tricyclic antidepressants - Tx

- ABCs
- Bicarbonate drip
  - Reduces cardiac effects
- Control seizures
  - Benzodiazepines
  - Phenobarbital
  - Avoid phenytoin – risk of dysrhythmias

Case 3:

- 27 yo F brought in by family. Confused and vomiting. "She took some Tylenol this morning" (about 4 hours ago)
- P125 BP135/65 T99.4 Warm, dry skin. Oriented x 2. Sometimes nonsensical answers. +gag reflex. Dilated pupils.
- What do you need to know?
- Does this fit with a Tylenol OD?

Case 3

Gary Seidman, Flickr

Case 3

- What are your initial orders?
  - Hint: ABC, IV, O2, monitor
  - What labs / tests do you want?
  - Medications?

Case 3

- Acetaminophen level – 375 mg/dl
- What next?

Case 4

- 32 yo M brought in because of violent behavior
- Agitated and combative
- P125 BP 160/95 T99.4
- Warm & sweaty. Dilated pupils. Exam otherwise non-focal
- Differential?

Case 4

- UDS – cocaine positive
- Treatment?

Slides & content for this lecture developed by

Stacey Noel, MD

With revisions by

Colin Greineder, MD & Laura Hopson, MD