



Emergency Toxicology

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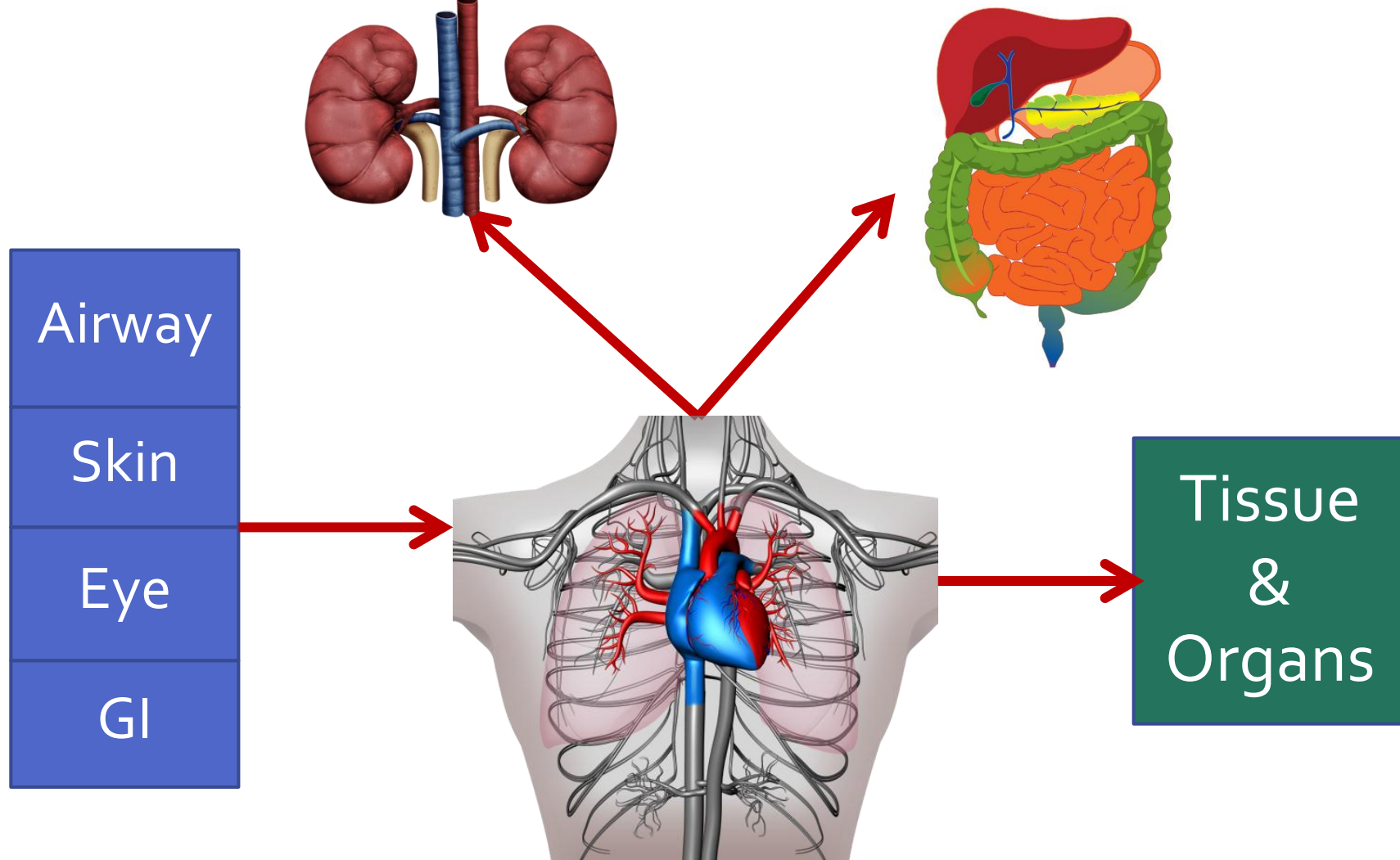
Determination of Toxicity

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graph LR; A[Determination of Toxicity] --> B[Dose]; A --> C[Route of exposure]; A --> D[Host]; B --- E[Therapeutic index]; C --- F[GI, Inhalation, Cutaneous]; D --- G[Extreme age, Pregnancy];
```

Dose Therapeutic index

Route of exposure
GI, Inhalation, Cutaneous

Host
Extreme age, Pregnancy



Decontamination

**Enhanced
Elimination**



Approach

“Attempts to identify the poison should not delay care”

- Always start with **“ABC’s”**
- ACLS algorithms apply with few exceptions
- Once stable
 - minimize bioavailability
 - history & physical exams

General Approach

A : Airway

B : Breathing

C : Circulation

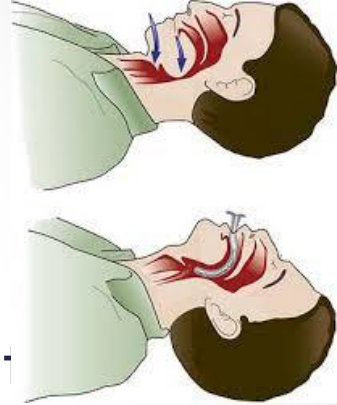
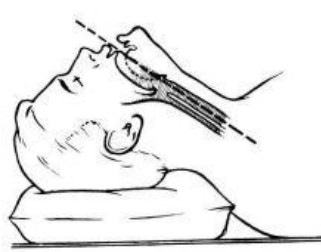
D : Disability, Diagnosis — history, physical exams,
investigation, Decontamination

E : Enhanced Elimination

F : Find antidote

G : Get Tox consult if needed

Airway



- Flaccid tongue, aspiration, respiratory arrest
- Mental status & gag/cough reflex
- Sniffing position, jaw thrust
Head-down, left-sided position
Oropharynx – FB, secretions

Intubation?

- Naloxone first in opioids overdose



Breathing



- O₂ *except Paraquat!!*
- Correct hypoxia
- ABG: pCO₂ > 60 → intubation
- Lung
 - Bronchospasm: *Albuterol nebulizer*
 - Bronchorrhea/crepitations: *Atropine?*
 - Stridor: *Intubation?*

Circulation

- IV access
- Blood work, CBG
- Hypotension
 - NS 10-20 ml/kg
 - Vasopressors if still hypotensive: Dopamine
 - PRC if bleeding / anemic
- Hypertension
 - Nitroprusside, β -blocker
- ECG: arrhythmias, treat accordingly



Disability

Altered mental status

- Hypoxia
- Opioid intoxication
- Hypoglycemia
- Wernicke's encephalopathy
- CNS depressants

→ *Coma Cocktail*



Coma Cocktail



Diagnostic & Therapeutic

- O₂
- Thiamine: 100 mg IV
- Dextrose: 50%, 50 mL IV
- Naloxone: 0.01 mg/kg IV

➤ Seizure

- Diazepam 0.1–0.2 mg/kg IV
- Midazolam 0.1–0.2 mg/kg IM or 0.05–0.1 mg/kg IV
- Phenobarbital 10–15 mg/kg IV over 15–20 min



Pyridoxine - isoniazid, Pralidoxime & Atropine - organophosphate/ carbamate

➤ Agitation → Haloperidol 5-10 mg IM

➤ Trauma?

- Foley catheter
- Rectal temperature



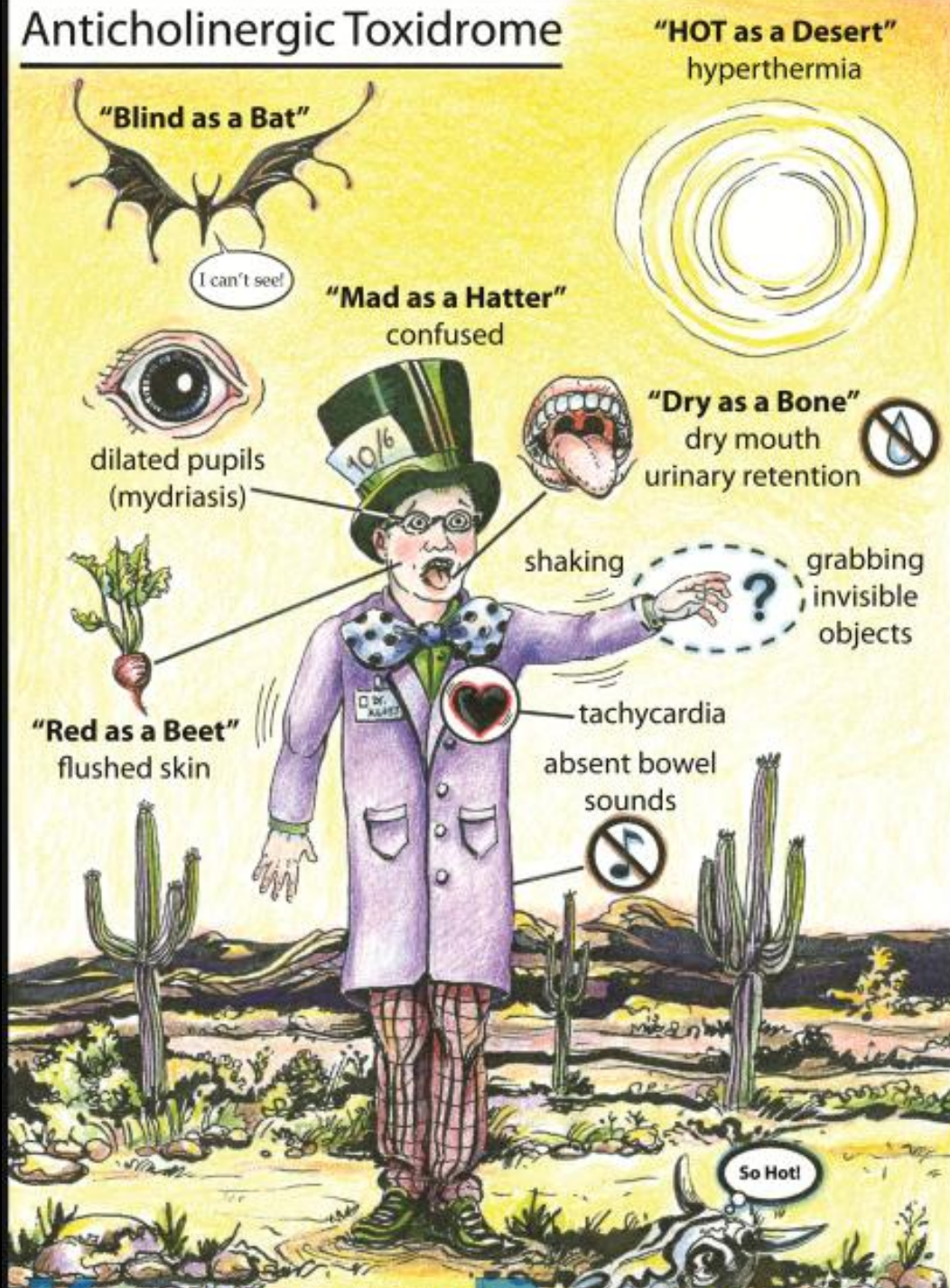
Cardiac Arrest ?

Toxin	Intervention
<u>Toxins with specific antidote</u> Digoxin Organophosphates Envenomation	<u>Antidote</u> Digoxin Fab Atropine Antivenom
Sodium channel blocker / wide-complex tachycardia	Sodium bicarbonate
Calcium channel blocker / β -blocker High-dose	Insulin
Local anesthetic agents Lipophilic cardiotoxins	IV lipid emulsion

Exposure

- Toxidrome ?
- Poisoning ?
- Overdose ?
- Drug interaction ?
- Withdrawal ?

Anticholinergic Toxidrome



- Atropine
- Benztropine
- TCA
- Antihistamines (CPM)
- Antipsychotics (Clozapine)



Amanita muscaria



*Amanita
pantherina*
เห็ดเกล็ดดาว

Jimson weed, angel's trumpet
มะเขือบ้า ดอกลําโพง แตรนางฟ้า

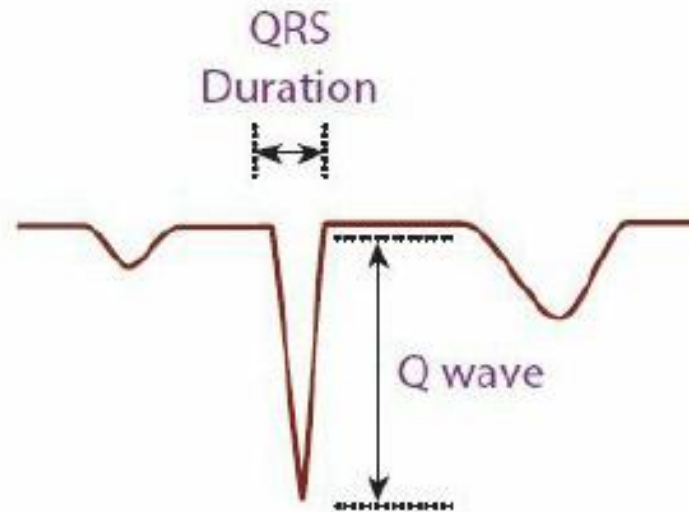


Treatment

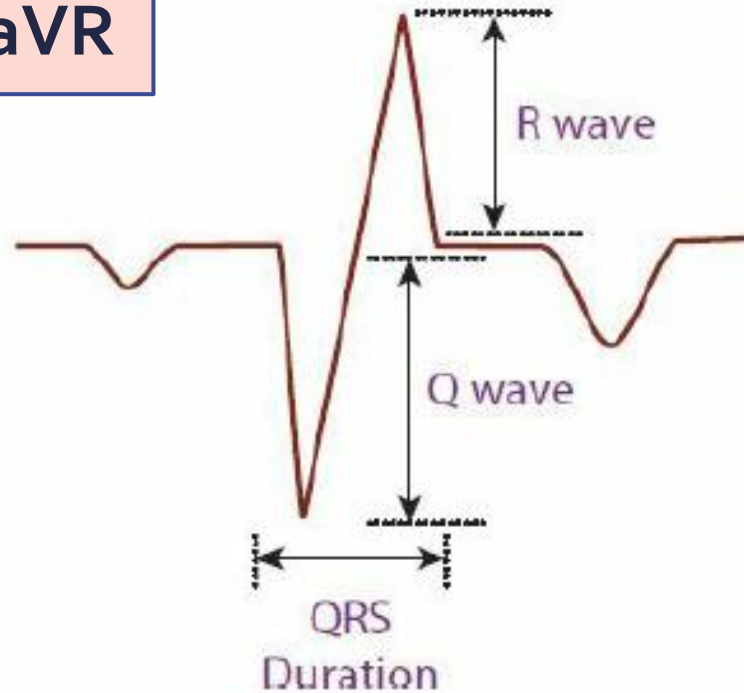


- **Physical restraints**
- **Pharmacologic sedation:**
 - IV benzodiazepine**
- **Physostigmine - controversial**

Normal aVR



Abnormal aVR



10 mg



25 mg



50 mg



75 mg

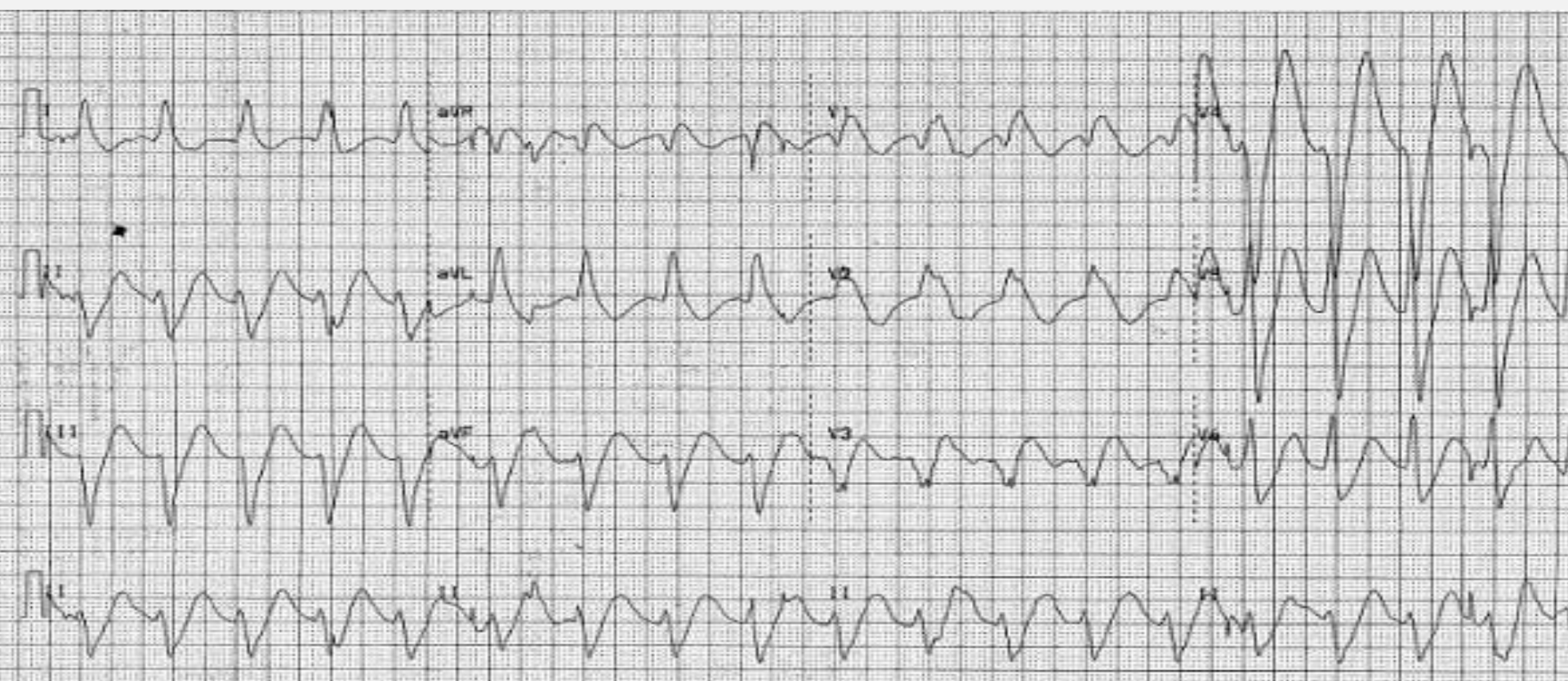


100 mg

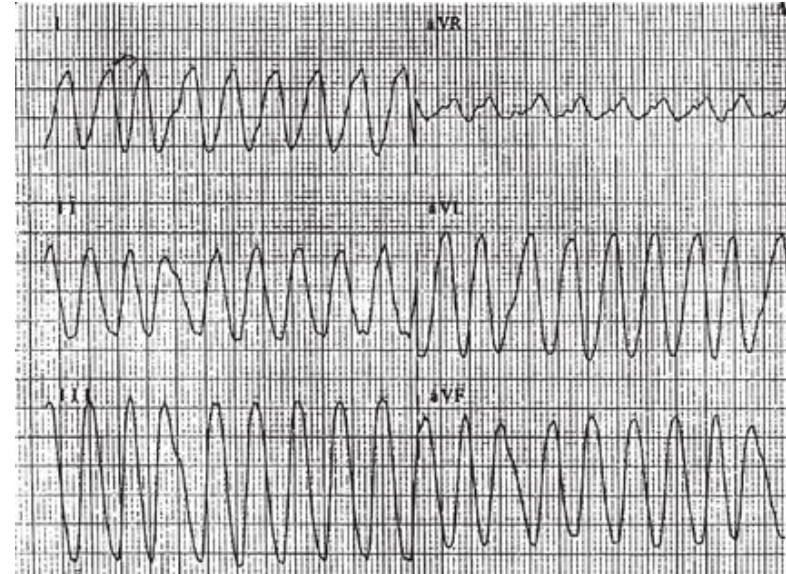


150 mg





TCA Overdose



Sodium bicarbonate

- Wide QRS > 100 ms, ventricular dysrhythmia, hypotension refractory to fluid
- 1–2 mEq/kg bolus (to serum pH 7.50- 7.55)

Cholinergic

Acetylcholine signaling at synapse



- Acetylcholine (ACh)
- U ACh Receptor
- ~ Signal transmission

ACh Esterase STOPS signaling process

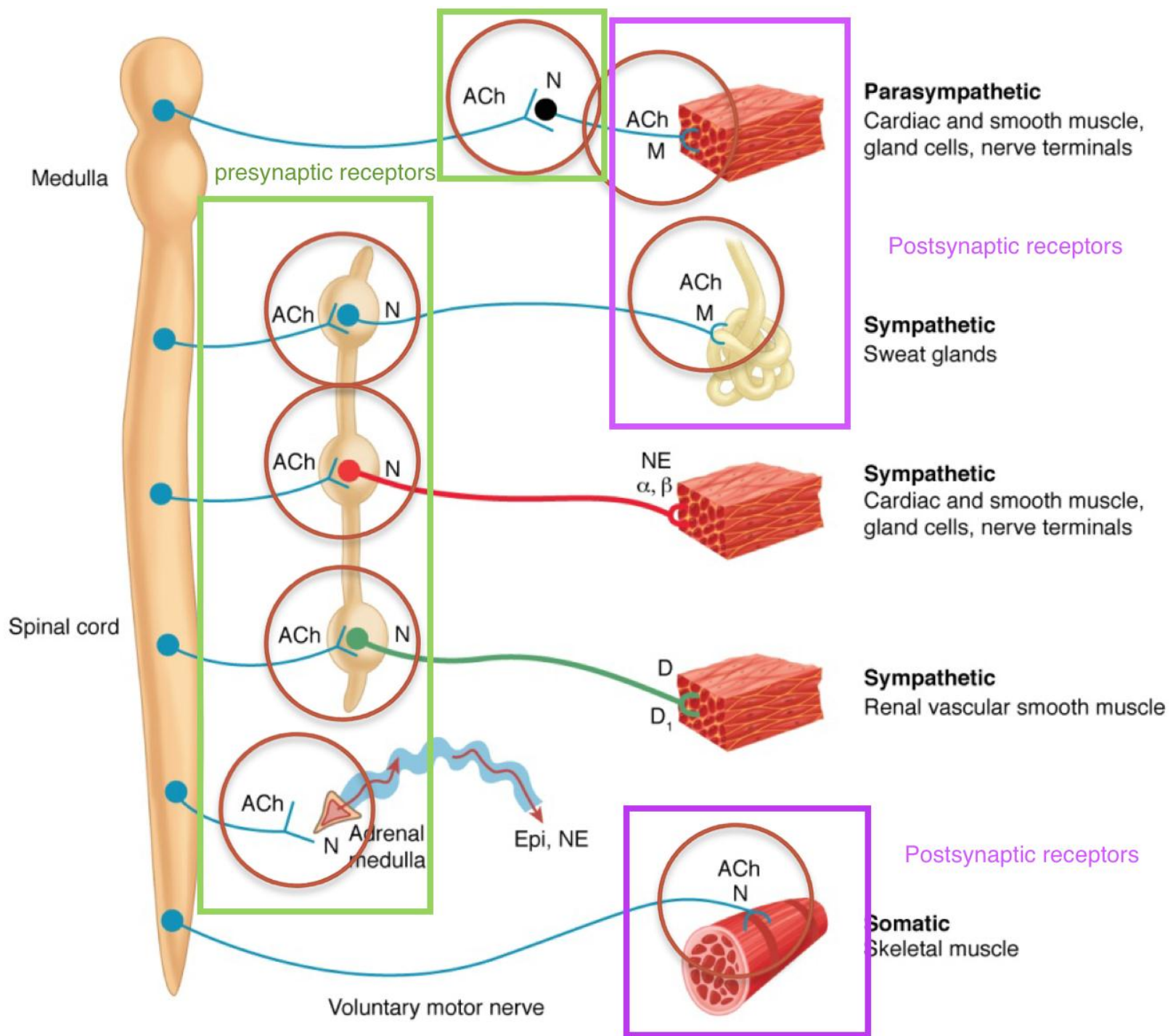


- ACh
- U ACh Receptor
- ~ Signal transmission
- ★ ACh Esterase

OP's inhibit ACh Esterase



- ACh
- U ACh Receptor
- ~ Signal transmission
- ★ ACh Esterase
- ▶ Organophosphate pesticide (OP)



Muscarinic

Salivation

Lacrimation

Urination

Defecation

GI upset

Emesis

Bronchospasm

Bradycardia

Bronchorrhea

SLUDGE-BBB

Pilocarpine, Mushroom

Organophosphates, Carbamates

Nicotinic

Mydriasis

Tachycardia

Weakness

HyperTension

Fasciculation

Mon - Fri

Tobacco

Organophosphates

Carbamates

Pesticide, Nerve agent

- Organophosphates – irreversible
- Carbamate - reversible



ด่วน!

จับตาปีติพงศ์ พึ่งบุญ ณ อยุธยา
และรัฐบาลพลเอกประยุทธ์ จันทร์โอชา
เมื่อวันที่ยกยักใหญ่สารเคมีสหรัฐ

DU PONT

FMC

พลักดันกรมวิชาการเกษตรให้ขึ้นทะเบียนสารเคมีกำจัดศัตรูพืช
ที่มีพิษภัยร้ายแรงและหลายประเทศทั่วโลกห้ามใช้

คาร์โบฟูราน & เมโทมิด



คาร์โบฟูรานหรือฟุราดาน ถูกห้ามใช้แล้วในสหรัฐ สหภาพยุโรป
หลายประเทศในแอฟริกา และประเทศเพื่อนบ้านในอาเซียน



เมโทมิดหรือแลนเบก ถูกห้ามใช้แล้วใน อังกฤษ เยอรมนี
ฟินแลนด์ สิงคโปร์ มาเลเซีย ลาว และกัมพูชา เป็นต้น



Alpa Press / Rex Features



Inocybe



Clitocybe

Cholinergic

Antidote

- **Atropine** - muscarinic effects
- **Pralidoxime** - reverse phosphorylation of cholinesterase

Opioid

- ❖ RR , BP , BT ↓
- ❖ Lethargy , coma
- ❖ Miosis , bowel sound ↓
- ❖ Respiratory arrest, cardiac arrest
- ❖ DDX: Pontine / Cerebellar lesion

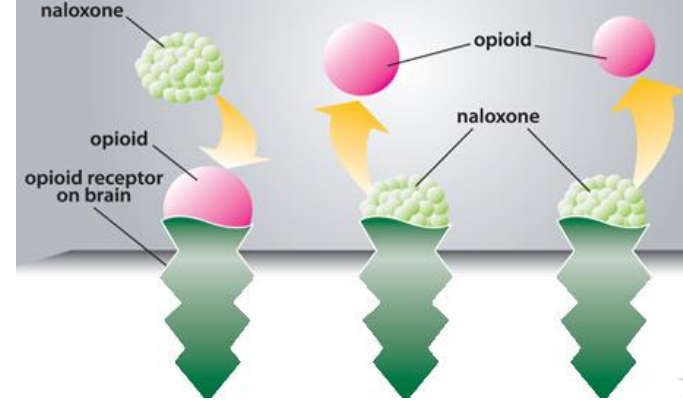




Classical triad

1. Pinpoint pupils
 2. Respiratory depression
 3. Coma
- Respiratory status = indicator for response of naloxone
 - *Naloxone* 0.01 mg/kg IV (Adult) , IV/IM (child)
 - effective in 1-3 min
 - no response after 3 min → titrate 0.4 → 2 → 4 , Max 10-20 mg
 - Completely reverse symptom 20 – 60 min

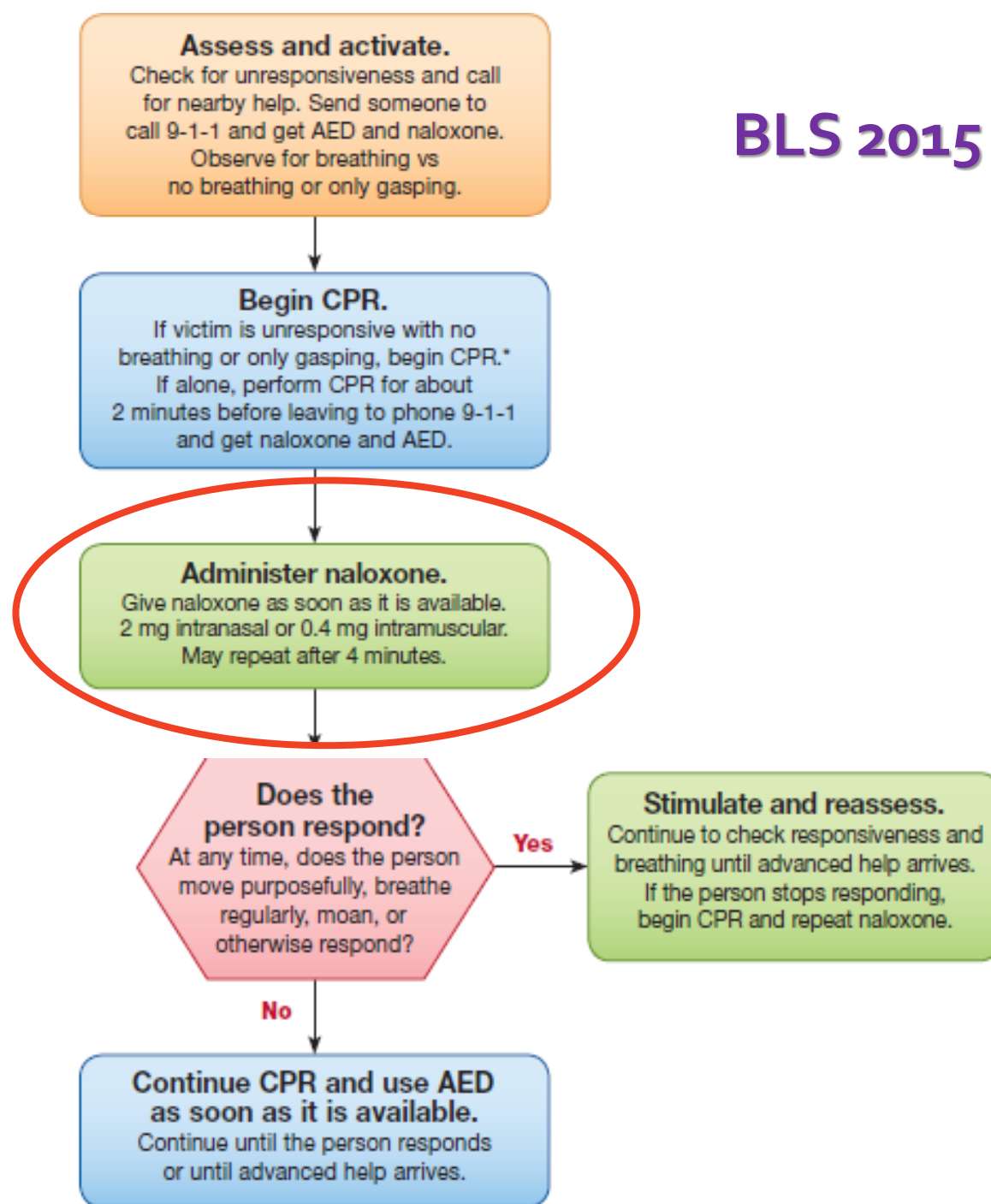
Naloxone



- Potent opioid receptor antagonist
- Acute withdrawal syndrome
 - Rarely life-threatening
 - Hypertension, tachycardia, piloerection, vomiting, agitation, drug cravings
 - Minimize; use lowest effective dose, opioid dependency



BLS 2015



ACLS 2015

Respiratory Arrest

- Bag-mask ventilation
- Naloxone: perfusing cardiac rhythm
- Ventilation until spontaneous breathing, standard ACLS if no spontaneous breathing (Class I, LOE C-LD)

Cardiac Arrest ?

- No recommendation, **Standard ACLS**

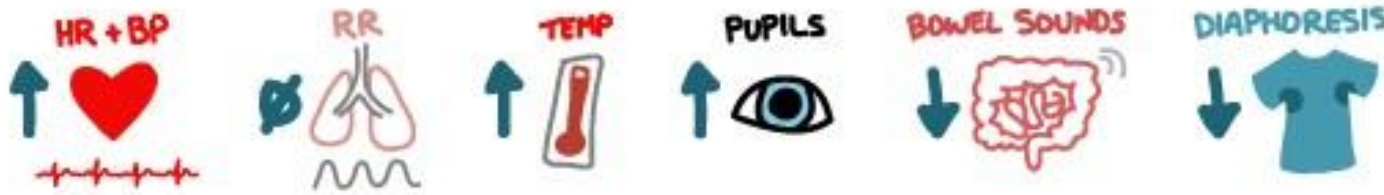
Sympathomimetic

- CNS excitation, convulsion
Hypertension, tachycardia, fever
Mydriasis, bowel sound ↓
Diaphoriasis, hyperreflexia
- β -adrenergic- theophylline, caffeine, albuterol
 α -adrenergic- phenylephrine, ทิฟฟี-ดีคอลเจน
Mixed- amphetamine, cocaine



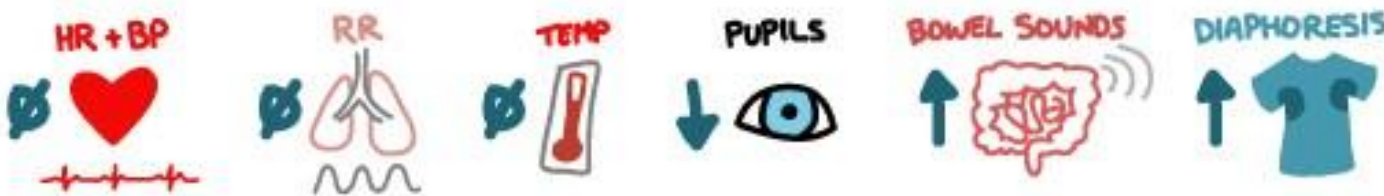
Anticholinergic

Low potency antipsychotics
Oxybutinin, Ipratropium
ACh receptor antagonists



Cholinergic

ACh receptor agonists
AChEIs ie. Donepezil



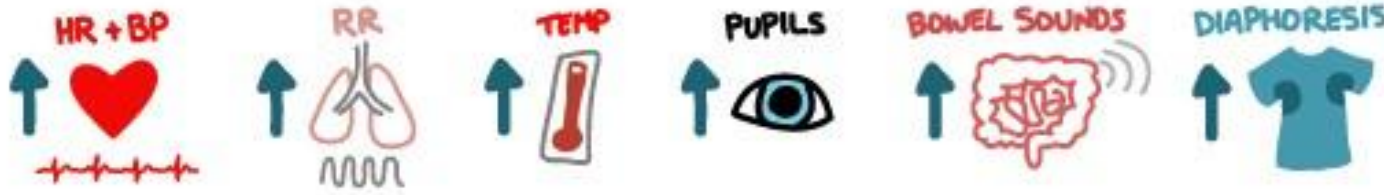
Opioid

Morphine
Heroin
Hydromorphone



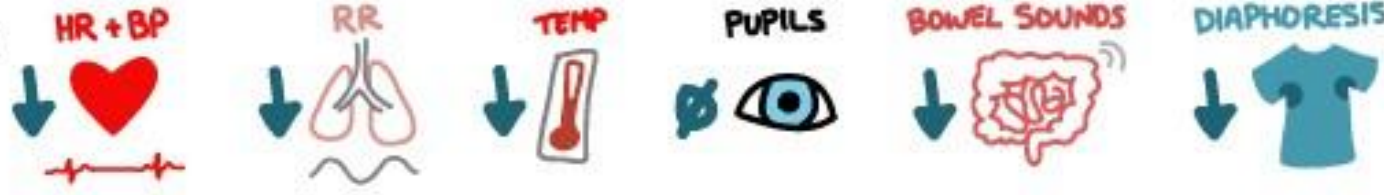
Sympathomimetic

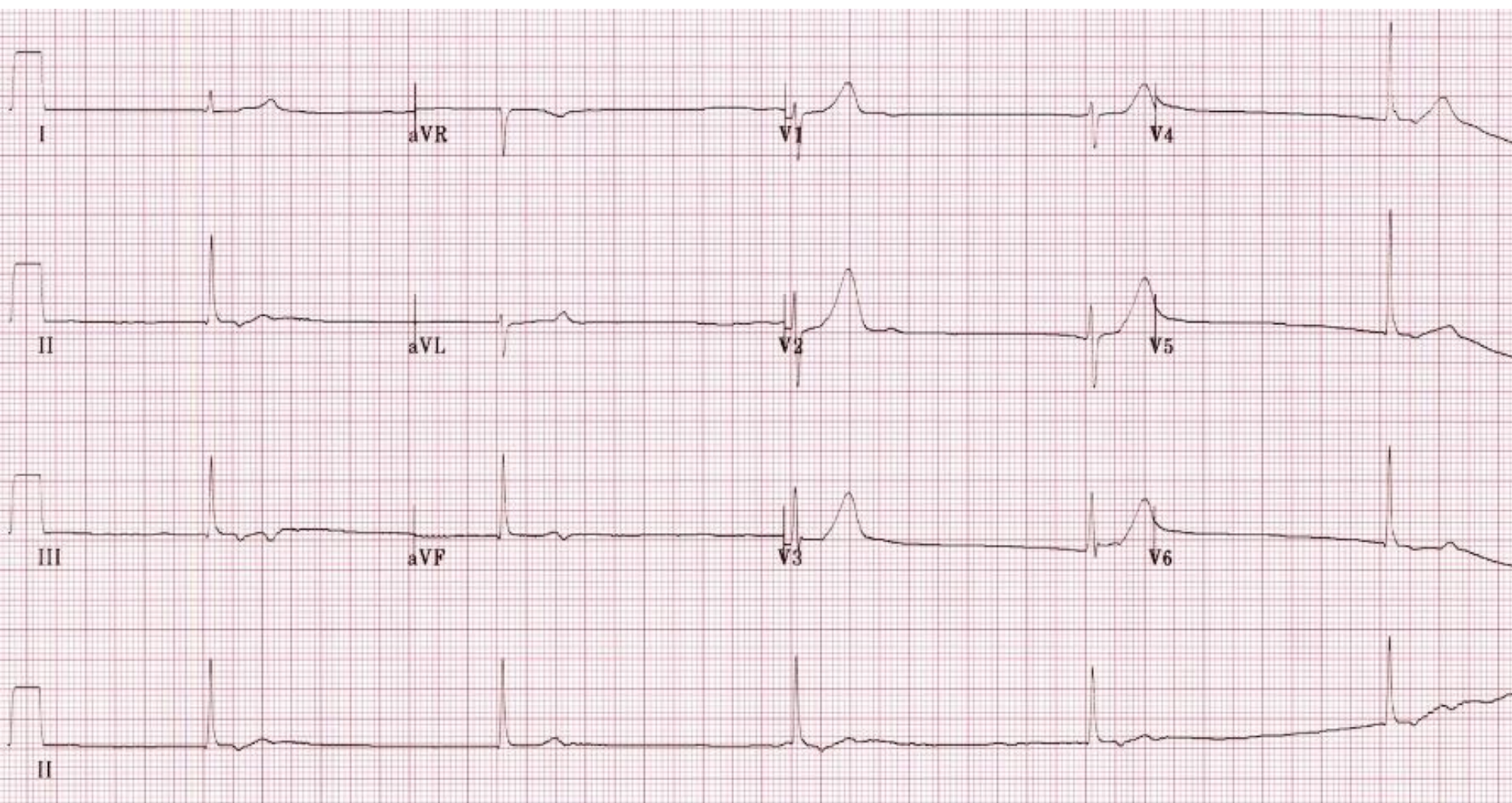
Epinephrine
Cocaine
Amphetamine & methylphenidate

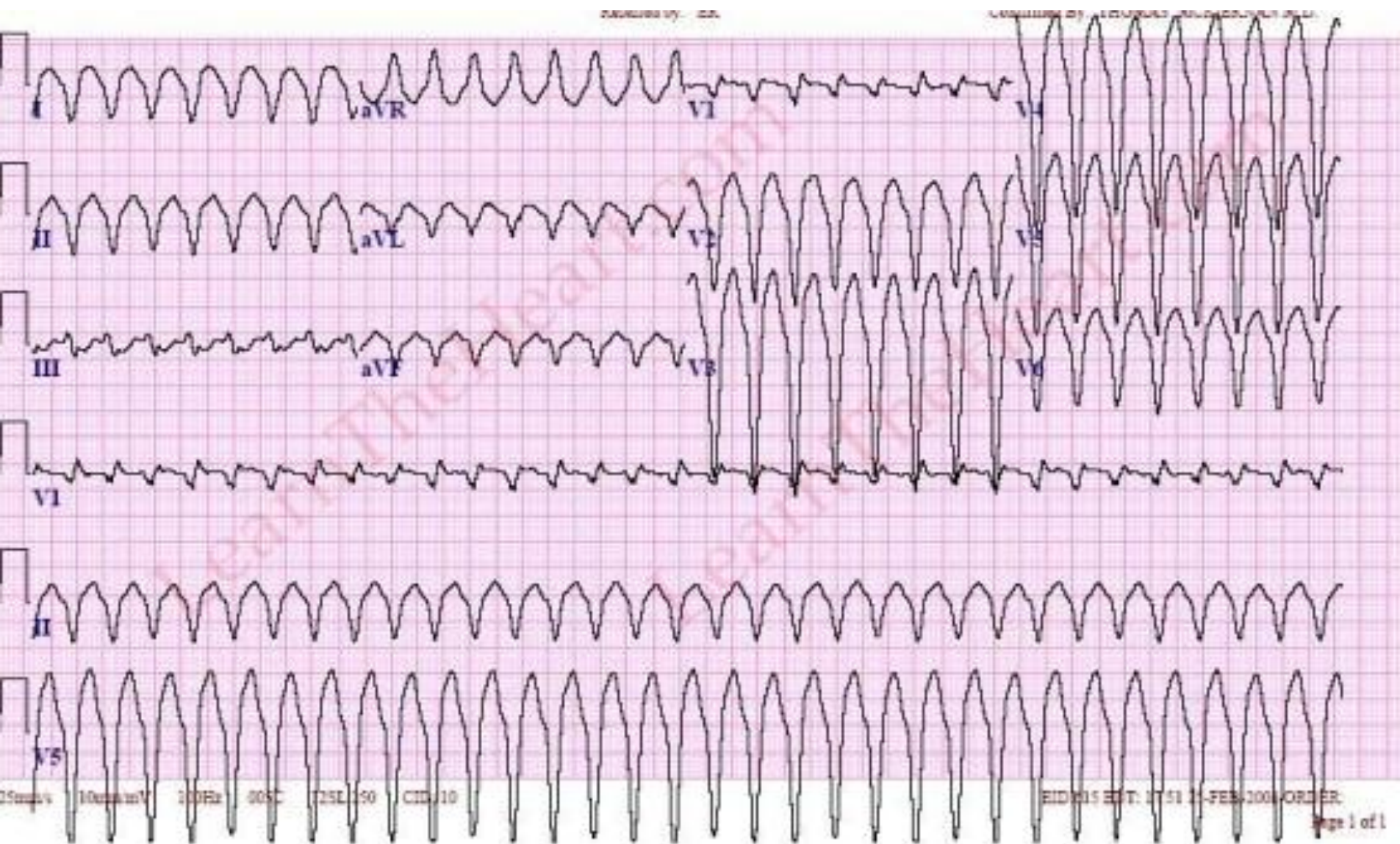


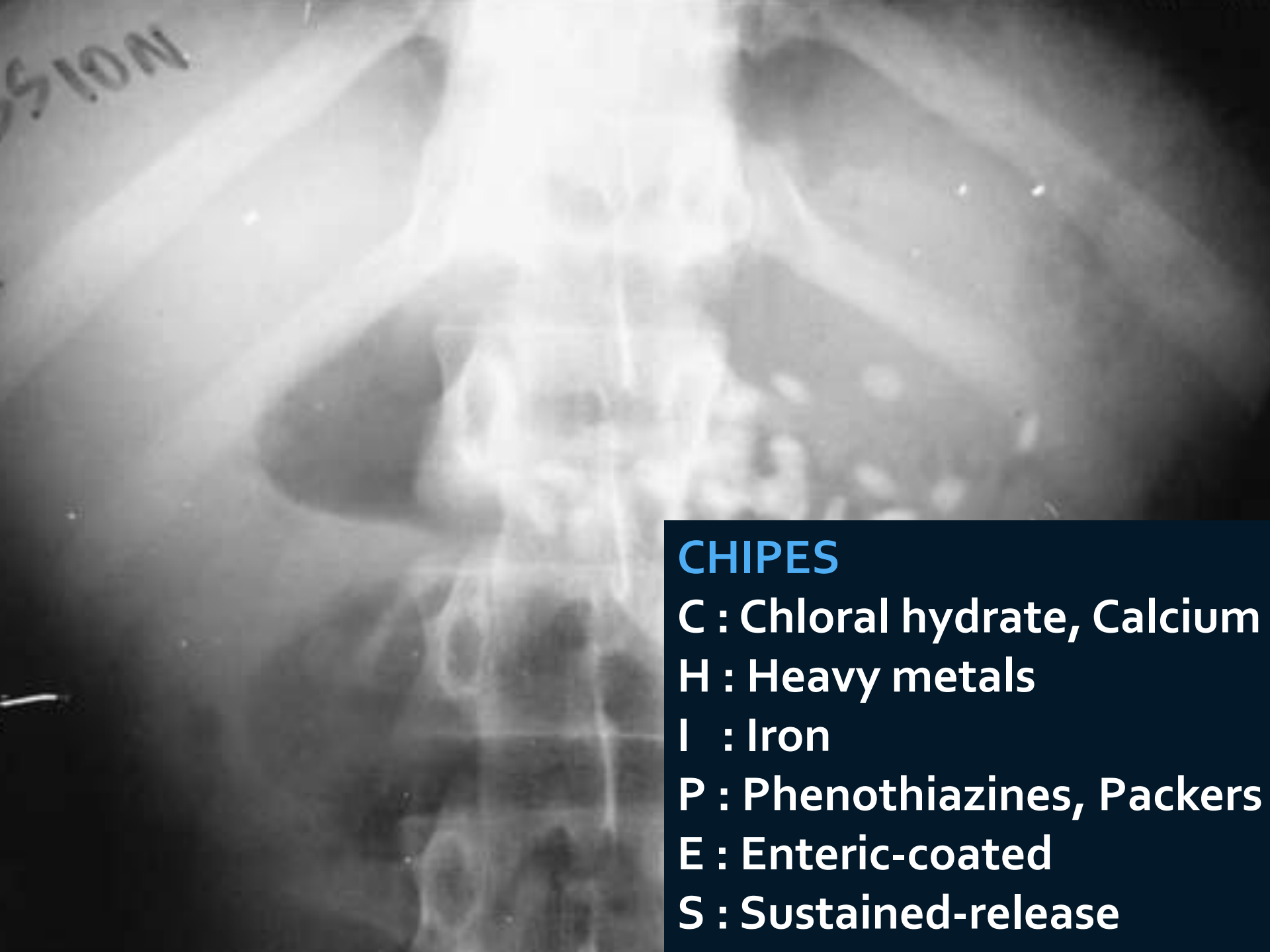
Sedative-Hypnotic

Benzos & barbs
"Z-drugs" (ie. zopiclone)
Antihistamines









CHIPES

C : Chloral hydrate, Calcium

H : Heavy metals

I : Iron

P : Phenothiazines, Packers

E : Enteric-coated

S : Sustained-release

Decontamination

- ❖ Skin decontamination
- ❖ Eyes decontamination
- ❖ GI decontamination
 - Syrup of Ipecac
 - Gastric lavage
 - Activated charcoal
 - Whole Bowel Irrigation

Skin decontamination

- Protect yourself & HC workers
- Remove clothing
- Corrosive agents- skin, systemic effect
- Flush with water / NS
- Soap & shampoo - oily



Eyes decontamination

- Corrosive agents & hydrocarbon
- Remove contact lens
- Irrigate with full eyelids retraction ≥ 20 min,
 - $> 1-2$ hr for base
- Medial to lateral, > 1 L
- pH paper : 7.4
- Slit lamp





GI decontamination

Syrup of ipecac Not recommended

Gastric lavage

- Not routine !!
- Within 60 min after ingestion
- Reduce small pill, pill fragment
- Effective 19 – 70 %

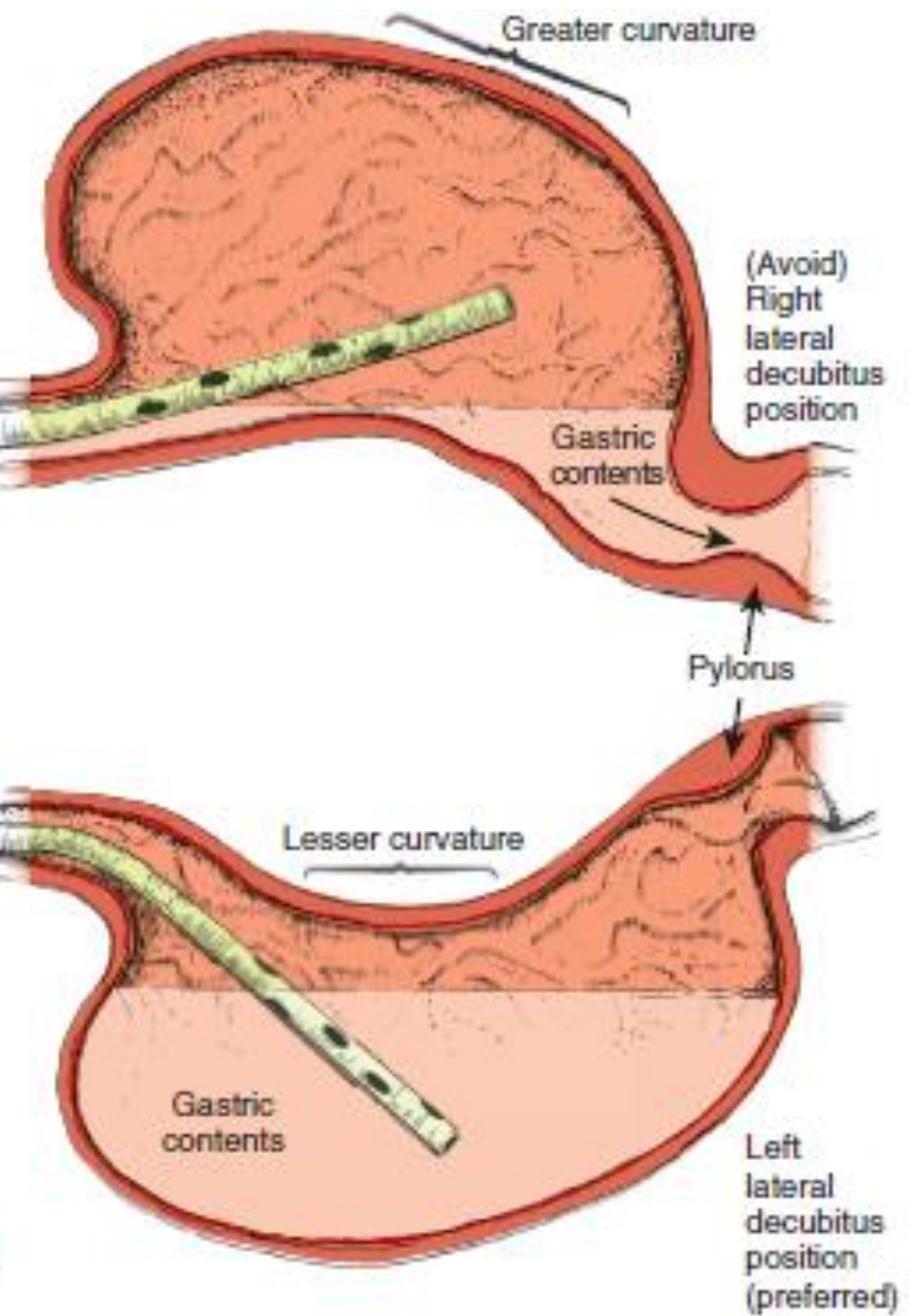
Gastric Lavage

Contraindication

- Alteration of consciousness (need intubation)
- Corrosive *except hydrofluoric, paraquat, phenol*
- Hydrocarbon
- Sustained-release / enteric-coated
- Non toxic

Complication

- Perforation, nosebleed, vomiting, aspiration





Activated charcoal

- Within 60 min, 1 g / kg orally
- Superior to lavage
- Awake / intubated
- Contraindication: bowel obstruction, ileus, GI perforation, not absorbed by AC
- Complication: vomiting, aspiration, bezoar formation



Not good for
CHAMPS

C : caustics

H : hydrocarbons

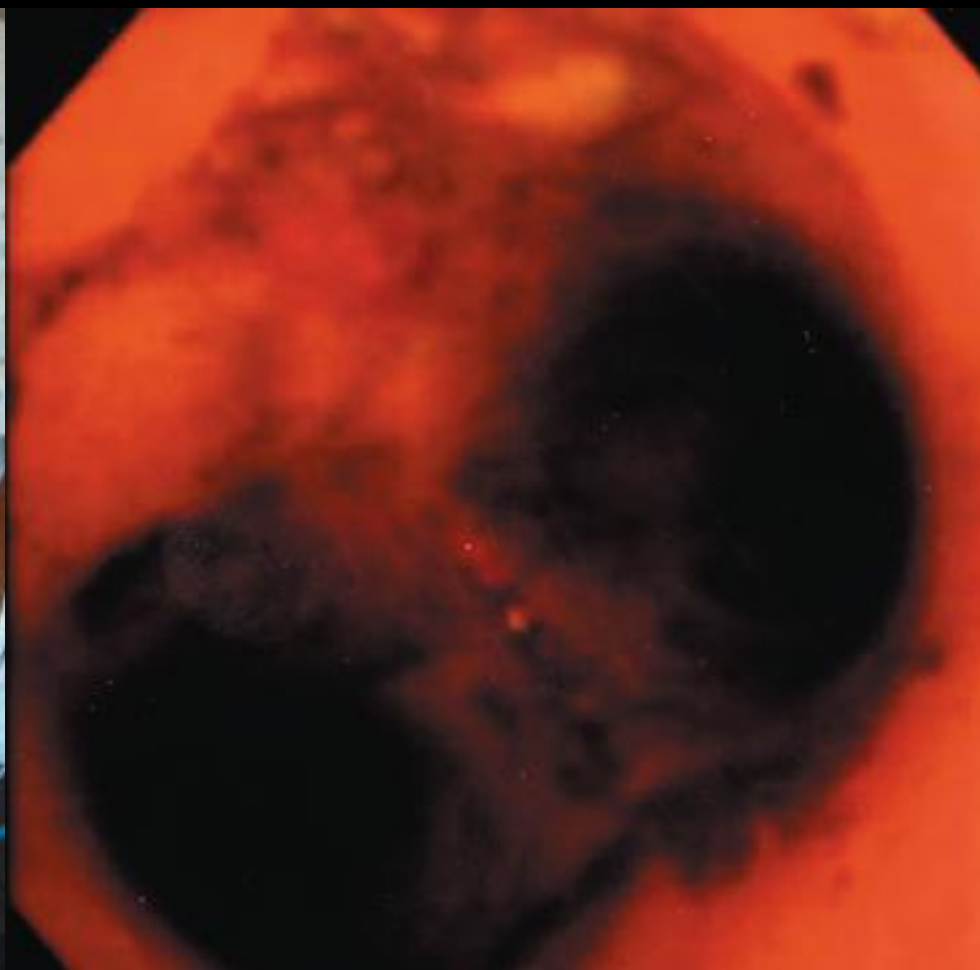
A : alcohols

M : metals

P : Pb

S : Salts





Whole bowel irrigation

- 1.5-2 L/h - adults
- 25 mL/kg/h - children
- NG tube / oral ingestion
- End point :
Clear rectal effluent



NDC 0378-6669-40

POLYETHYLENE GLYCOL 3350 and ELECTROLYTES FOR ORAL SOLUTION, USP

When reconstituted with water to a volume of 4 liters, this solution contains 125 mmol/L sodium, 10 mmol/L potassium, 40 mmol/L sulfate, 20 mmol/L bicarbonate, 35 mmol/L chloride and 17.6 mmol/L polyethylene glycol 3350.

Each disposable jug contains, in powdered form: polyethylene glycol 236 g, sodium sulfate (anhydrous) 22.74 g, sodium bicarbonate 6.74 g, sodium chloride 5.86 g, potassium chloride 2.97 g.

B only



Indication

- Enteric coated / sustained-release tablets
- Foreign body
- Iron, Lithium, heavy metal
- Body packers / stuffers

Contraindication

- Unprotected / compromised airway
- Bowel obstruction / ileus

Adverse effects

- Nausea & bloating, regurgitation & aspiration





Enhanced Elimination

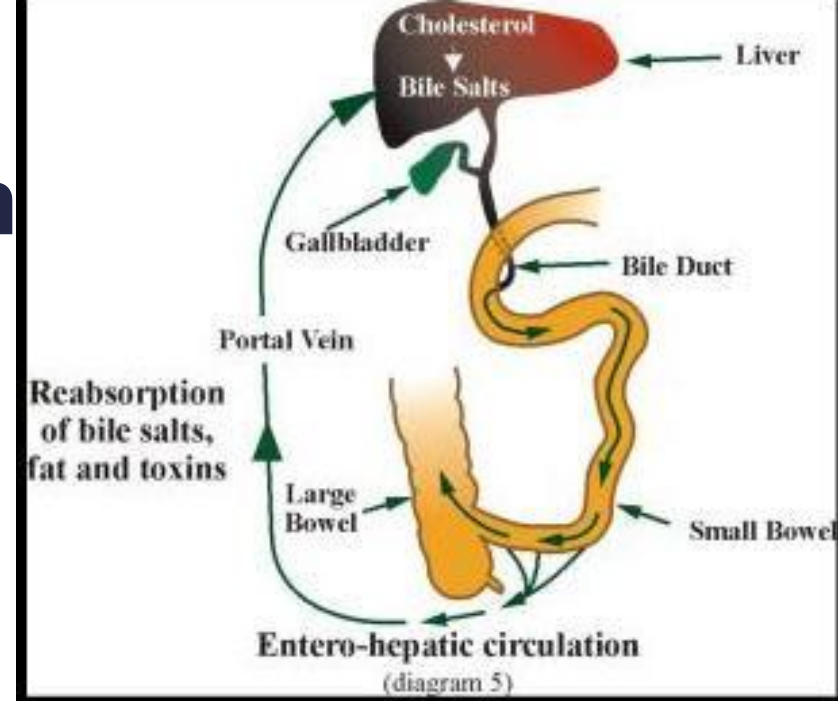
Multidose activated charcoal

Indication

Enterohepatic recirculation

Dose

- Initial loading : 1 g/kg orally / gastric tube then 0.5 g/kg q 2-3 hr for 12-24 hr followed by stool softening agent



These People Drink Charcoal Quickly

Theophylline

Phenobarbital

Dapsone

Carbamazepine

Quinine

Contraindication

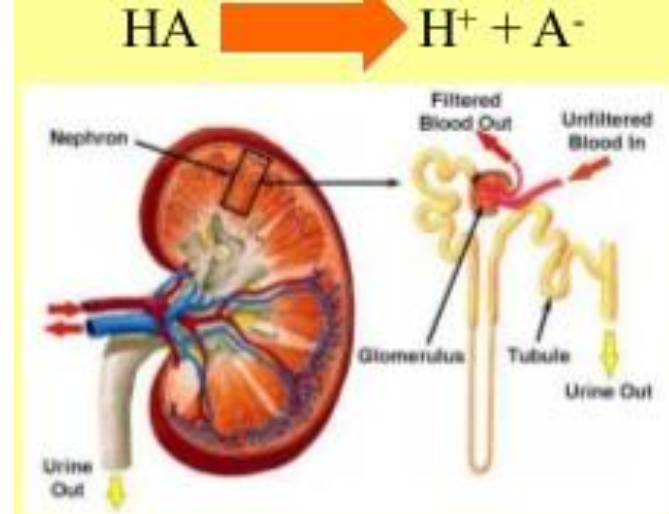
- Intestinal obstruction
- Ileus

Complication

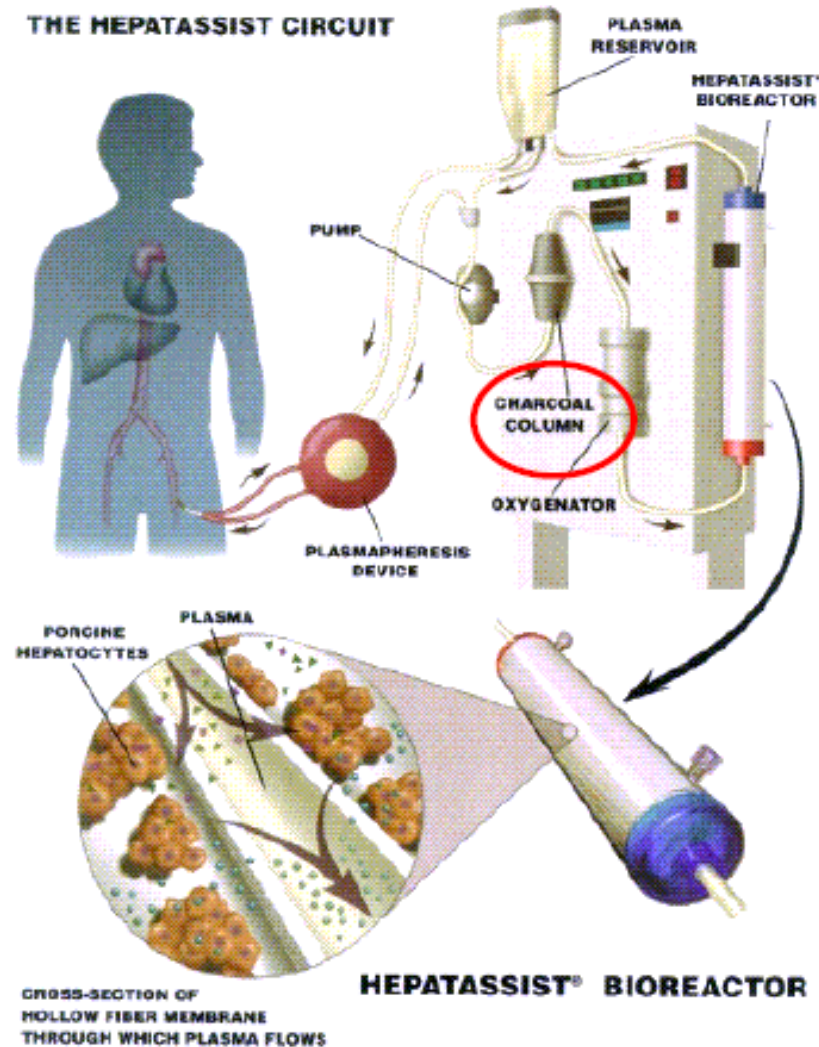
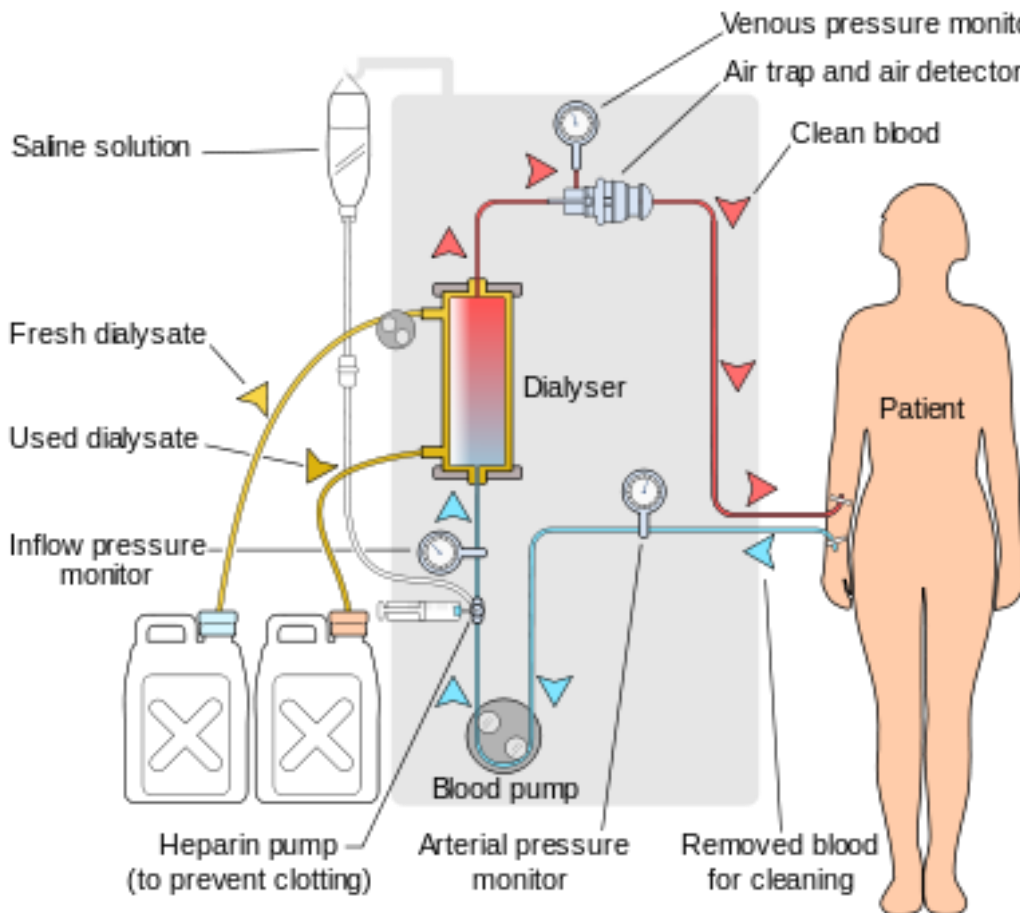
- Fluid & electrolyte disturbance

Urine alkalization

- “Ion trap” ; weak acid
- Salicylate, phenobarbital, 2,4D, TCA, methotrexate
- Dose: NaHCO_3 1-2 mEq/kg then infusion, keep urine pH 7.5-8.5 (TCA; serum 7.5 – 7.55)
- Contraindication: volume / sodium overload, hypokalemia, renal insufficiency
- Complication: pulmonary edema, pH shift, hypokalemia



Extracorporeal Removal Technique



Hemodialysis

Hemoperfusion

<u>Find Antidote</u>	Adult Dose	Indication
Calcium gluconate	10%, 10–30 mL IV	Hypermagnesemia Hypocalcemia
<i>Cyanide antidote kit</i> -Amyl nitrite -Sodium nitrite -Sodium thiosulfate	-1 ampule O ₂ chamber of ventilation bag 30 s on/30 s off -3%, 10 mL IV -25%, 50 mL IV	-Cyanide Hydrogen sulfide (use only sodium nitrite) -Cyanide -Cyanide
Dextrose	1 gm/kg IV	Insulin Oral hypoglycemics
Digoxin Fab	5–10 vials	Digoxin & other cardioactive steroids
Flumazenil	0.2 mg IV	Benzodiazepines
Glucagon	3–10 mg IV	CCB β-Blockers

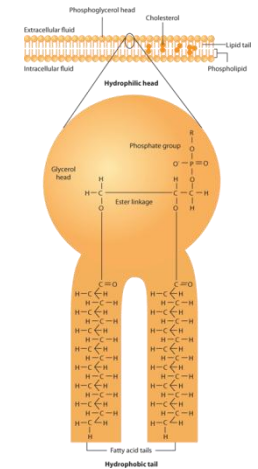
Antidote	Adult Dose	Indication
Methylene blue	1–2 mg/kg IV	Oxidizing toxins (nitrites, benzocaine, sulfonamides)
Pyridoxine	Gm for gm if known amount of isoniazid	Isoniazid <i>Gyromitra esculenta</i>
	5 gm IV	Hydrazine
Sodium bicarbonate	1–2 mEq/kg IV bolus followed by 2 mEq/kg/h IV infusion	Sodium channel blockers Urinary alkalinization
Thiamine	100 mg IV	Wernicke's syndrome Wet beriberi
IV lipid emulsion 20%	100-mL IV bolus over 1 min, follow by 400 mL IV over 20 min	Local anesthetic toxicity Rescue therapy for lipophilic cardiotoxins



Intravenous Lipid Emulsion



Local Anesthetic Systemic Toxicity (LAST)



- CNS (agitation → seizure/ CNS depression) → cardiovascular collapse
- Cardiovascular collapse refractory to standard therapy
- Neurologic & cardiovascular monitoring, dose fractionation, slow injection, epinephrine / ultrasound

ACLS 2015



- Concomitant with standard resuscitative care- **LAST**, particularly neurotoxicity/ cardiac arrest due to bupivacaine
- Other forms of drug toxicity failing standard resuscitation

TCA, β -blocker, CCB

Class IIb, LOE C-EO

Disposition?

- Patients with potentially serious overdose -observed for at least 6–8 hrs
- Beware of delayed complications from slow absorption of medications
- Psychiatric consultation - suicide risk



SI 02-4197777
RA 1367

**KEEP
CALM
AND
ASK A
TOXICOLOGIST**