



APPROACH TO THE POISONING

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Case 1

A 20-year-old man is brought to the emergency room by family.

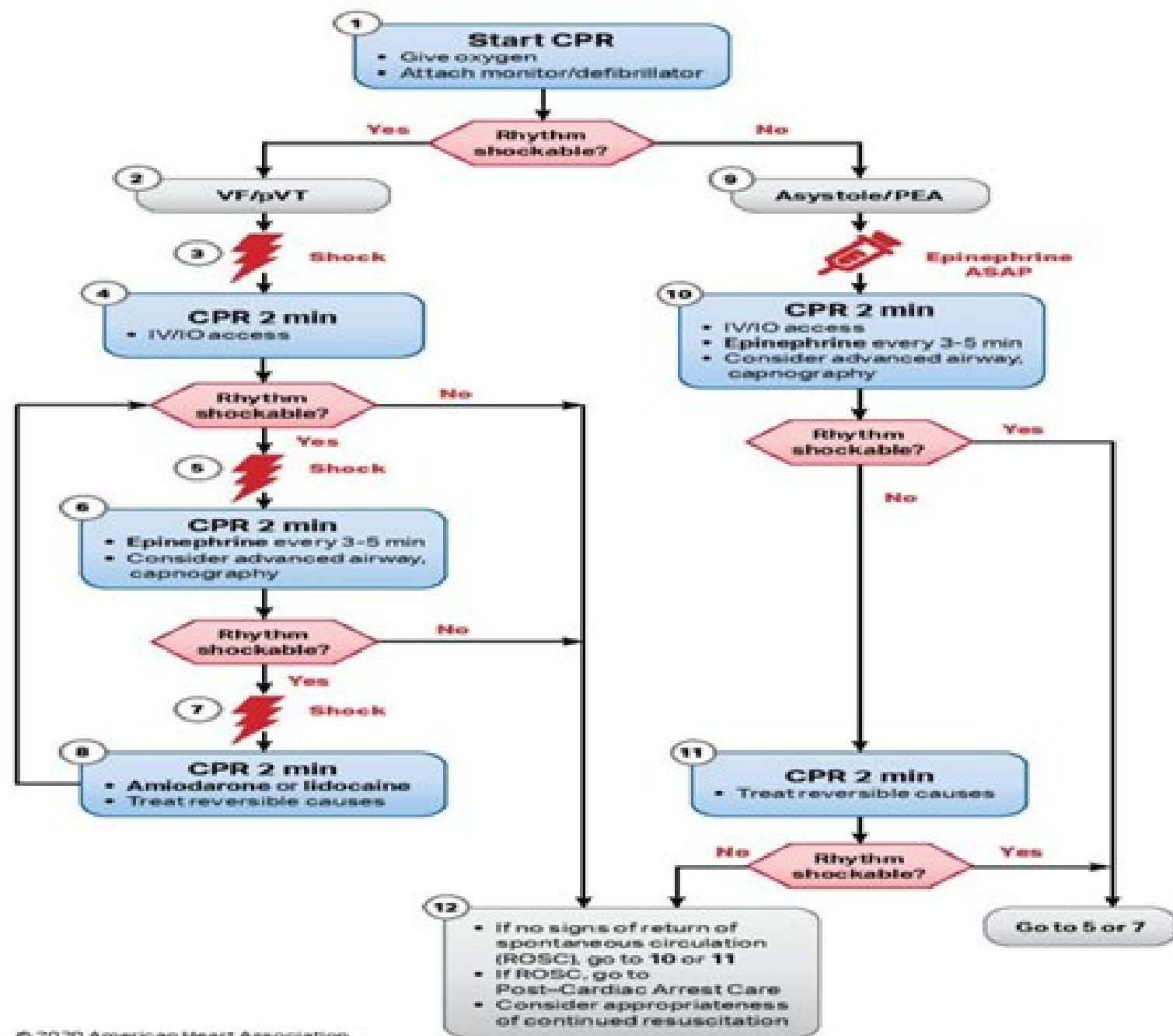
He is unresponsiveness.

What should you do ?

Case 1



Adult Cardiac Arrest Algorithm



NALOXONE

Naloxone is a nontoxic, diagnostic, and therapeutic antidote.

It is a competitive opioid antagonist administered IV, IM, or intranasally to reverse opioid-induced deleterious hypoventilation.

Naloxone can be used as a diagnostic agent when history and/or examination findings (respiratory rate of <12 breaths/min is a predictor of response to naloxone) suggest possible opioid exposure.

Using bolus doses, typically 0.1 to 0.4 mg.

Large initial bolus doses may precipitate vomiting and aspiration, acute opioid withdrawal, or an uncooperative, agitated patient.

NALOXONE

Naloxone may reverse the effects of opioids for 20 to 60 minutes, the effect of many opioids will outlast this time frame with possible return of respiratory depression.

Patients should be observed for 2 to 3 hours after administration of IV naloxone.

Case 2

An 18-year-old woman with an acute acetaminophen overdose 30 minutes prior to arrival in the ED.

On examination, her BP is 105/60 mm Hg, HR is 100 b/m, and RR is 24 b/m. Her pupils are equal and reactive bilaterally. Her sclera is clear, and her mucous membranes are moist. The lungs are clear and the heart sounds are regular. The abdominal examination is benign with normal bowel sounds. She is awake and alert without any focal neurologic deficits.

Orogastric Lavage

Indications	Rarely indicated Consider for recent (<1 h) ingestion of life-threatening amount of a toxin for which there is no effective treatment once absorbed
Contraindications	Corrosive/hydrocarbon ingestion Supportive care/antidote likely to lead to recovery Unprotected airway Unstable, requiring further resuscitation (hypotension, seizures)
Complications	Aspiration pneumonia/hypoxia Water intoxication Hypothermia Laryngospasm Mechanical injury to GI tract Time consuming, resulting in delay instituting other definitive care

TABLE 176-8 Principles to Minimize Complications From Orogastric Lavage

- Ensure a protected airway if consciousness level is reduced.
- Use a 36F- to 40F-gauge orogastric tube (22F to 24F in children).
- Position the patient on the left side with the head down 20 degrees.
- Pass lubricated tube down the esophagus a distance equal to that between chin and xiphoid process.
- Confirm tube position by insufflation of air.
- Gently lavage with 200 mL (10 mL/kg in children) of warm tap water, allowing drainage after each aliquot.
- Continue until returned fluid is clear.
- Consider administration of activated charcoal via orogastric tube before removal.

Activated Charcoal	Adults 50 grams orally, children 1 gram/kg orally
Indications	Ingestion within the previous hour of a toxic substance known to be adsorbed by activated charcoal, where the benefits of administration are judged to outweigh the risks
Contraindications	Nontoxic ingestion Toxin not adsorbed by activated charcoal Recovery will occur without administration of activated charcoal Unprotected airway Corrosive ingestion Possibility of upper GI perforation
Complications	Vomiting Aspiration of the activated charcoal Impaired absorption of orally administered antidotes

TABLE 176-9 Indications, Contraindications, and Complications of Enhanced Elimination Procedures	
Multidose Activated Charcoal	Initial dose: 50 grams (1 gram/kg children), repeat dose of 25 grams (0.5 gram/kg children) every 2 hours
Indications	Carbamazepine coma (reduces duration of coma) Phenobarbital coma (reduces duration of coma) Dapsone toxicity with significant methemoglobinemia Quinine overdose Theophylline overdose if hemodialysis/hemoperfusion unavailable
Contraindications	Unprotected airway Bowel obstruction Caution in ingestions resulting in reduced GI motility
Complications	Vomiting Pulmonary aspiration Constipation Charcoal bezoar, bowel obstruction/perforation

Case 3

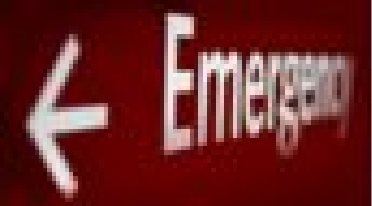
A 25-year-old man is brought to the emergency room by police because of suspected opioid intoxication.

He is noted to be very agitated (fighting against five burly policemen) and wild eyed.

On examination, his blood pressure is 180/100 mm Hg and heart rate 110 beats per minute.

He is noted to have rotatory nystagmus.

The neurologic examination reveals no focal abnormalities.



Phencyclidine (PCP)

Case 4

A 37-year-old man was admitted to the hospital emergency unit ~2 h after drug ingestion and upon admission, blood and urine samples were taken for standard biochemical and toxicological examination. the patient remained hypertensive (170/100 mm Hg), tachycardic (120/min), displayed prominent signs of psychosis and altered neurological status with GCS 10–12, as well as increased muscle tone with spastic leg postures. In addition, the patient gave no response to commands and only incomprehensible shouting. Patient was afebrile

Personal protective equipment; secure airway, breathing, circulation.

*Consider prolonged resuscitation effort (60 minutes) because intact neurologic survival is possible.



Check blood sugar (treat with 1 amp of D50); administer thiamine (100 mg IV/IM) and naloxone (0.4–2.0 mg q2–3min) if unresponsive.



Seizure control

1st-line benzodiazepines (BZD), 2nd-line barbiturates, avoid phenytoin.

Consider lorazepam 4 mg or diazepam 8 mg IV then phenobarbital 10–20 mg/kg IV or propofol 1 mg/kg IV.

*Pyridoxine up to 5 g IV if suspect isoniazid or mushroom poisoning



Correct hyperthermia (antipyretics ineffective).
Evaporative cooling, ice water immersion, ice packing, gastric lavage, peritoneal lavage

Collateral history from patient, family, or EMS; thorough physical exam

Contact Poison Control Center at 800-222-1222.

Initial workup: electrocardiogram, Tylenol level, ASA level, urinalysis with pH, hepatic function panel, comprehensive metabolic panel, pregnancy test (female), lactate, coagulation blood tests, salicylates, serum osmolality, serum ethanol level, blood gas (arterial or venous), chest x-ray, creatine kinase, carboxyhemoglobin, expanded urine drug screen

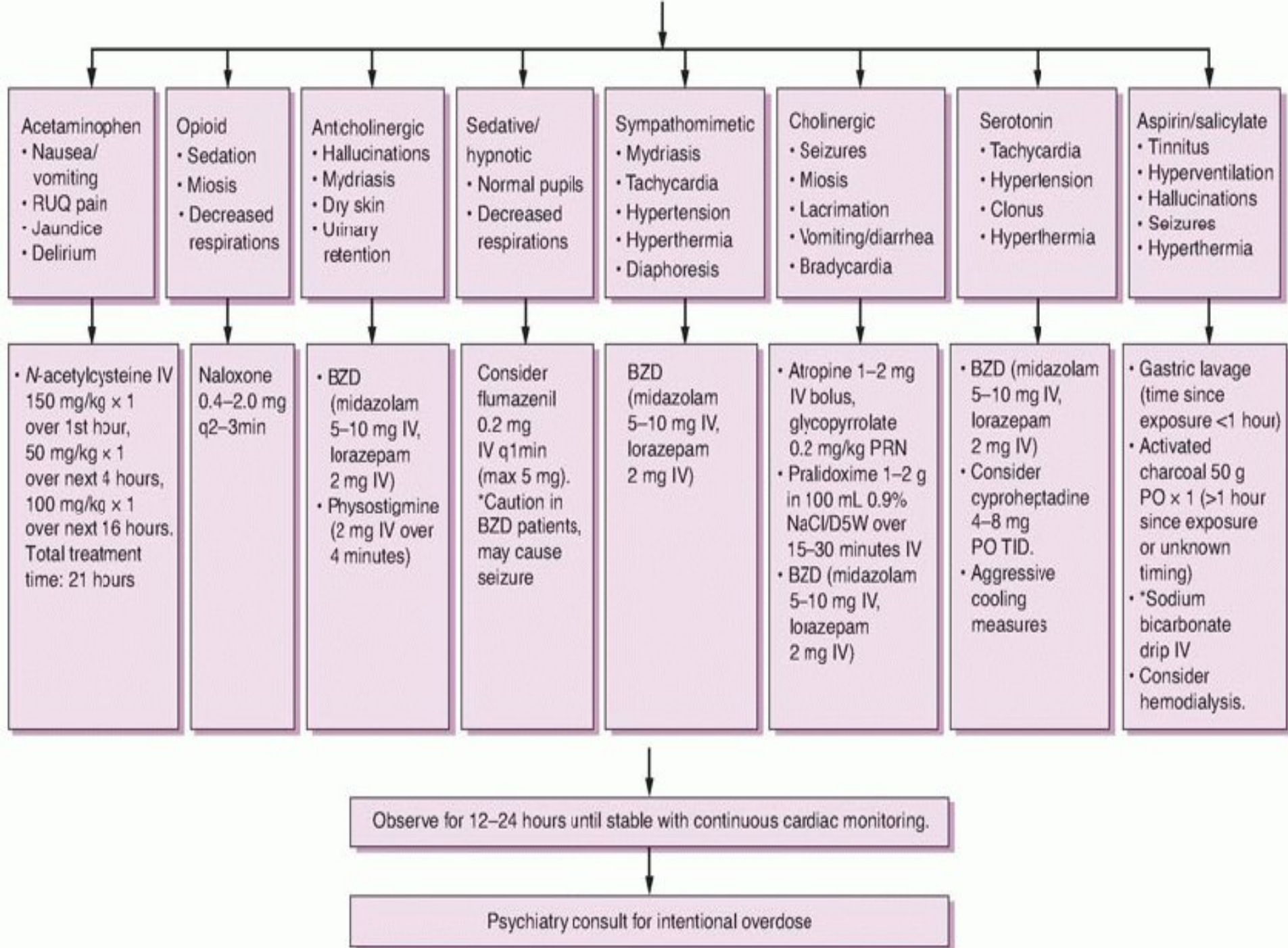
Consider drug immunoassay and drug levels for the following if indicated: digoxin, valproic acid, methotrexate, theophylline, carbamazepine, iron, lithium, phenobarbital, phenytoin, carbon monoxide, methemoglobin.

Bicarbonate for severe metabolic acidosis or widened QRS interval
*Instructions for drip below—titrate infusion to a target serum pH of 7.45–7.50.

GI decontamination only if supportive care not satisfactory and airway is secure. Consider activated charcoal 1 g/kg PO x 1 within an hour of ingestion or whole-bowel irrigation with polyethylene glycol at 1–2 L/hr via NGT.

Enhanced clearance with dialysis (aspirin, methanol, ethylene glycol, lithium, theophylline, isoniazid) or with urine alkalization (urine pH >7.5)
*Instructions for drip below—titrate infusion to a target urine pH of >7.50.

Go to "Poison Treatment" algorithm.



INTRODUCTION

Poisoning consumes substantial healthcare resources and causes many premature deaths.

Unintentional poisoning deaths are increasing, especially as a result of prescription analgesics.

Prevention is the key to reducing unintentional poisoning deaths.

Exposures occur by ingestion; inhalation, insufflation, cutaneous and mucous membrane exposure, and injection.

RESUSCITATION

assessment is used to identify patients who may benefit from an antidote, decontamination, or enhanced elimination techniques.

Prolonged resuscitation is generally indicated, as patients are often young with minimal preexisting organ dysfunction.

Utilization of extracorporeal cardiac and respiratory assist devices until organ toxicity resolves may be lifesaving.

Stabilization of airway, breathing, and circulation represents initial priorities.

Persisting hypotension despite an adequate volume infusion may respond to a specific antidote.

RESUSCITATION

May need an inotropic agent.

Inotrope choice is guided by knowledge of the toxin's toxicodynamic properties and assessment of circulatory status

Assessment of blood glucose concentration, temperature, and conscious state.

The proper use of antidotes is important, only a few are indicated before cardiopulmonary stabilization (e.g., naloxone for opiate toxicity, cyanide antidotes for cyanide toxicity, and atropine for organophosphate poisoning).

TABLE 176-1 Potential Interventions in Toxin-Induced Cardiac Arrest¹¹

Toxin or Toxin/Drug Class	Intervention
Toxins with a specific antidote (examples) Digoxin Organophosphates Envenomation	Antidote Digoxin Fab Atropine Antivenom
Sodium channel blocker or wide-complex tachycardia	Sodium bicarbonate
Calcium channel blocker or beta-blocker	High-dose insulin infusion
Local anesthetic agents Lipophilic cardiotoxins	IV lipid emulsion
Other Therapies to Consider	
Cardiac pacing	
Intra-aortic balloon pump	
Extracorporeal membrane oxygenation	

Table 40–3 • COMMON ANTIDOTES: DOSES AND INDICATIONS

Antidote	Pediatric	Adult	Poison
N-acetylcysteine	140 mg/kg PO, then 70 mg/kg PO q4h for 18 total doses OR 150 mg/kg IV over 15 min-1 h, then 50 mg/kg IV over 4 h, then 100 mg/kg over 16 h		Acetaminophen
Activated charcoal	1 g/kg PO		Most ingested poisons
Crotalidae polyvalent immune Fab	4-6 vials IV initially over 1 h; may be repeated 2 vials every 6 h for 18 h		Envenomation by Crotalidae
Calcium gluconate 10% (9 mg/mL elemental calcium)	0.2-0.25 mL/kg IV	10 mL IV	Hypermagnesemia, hypocalcemia (ethylene glycol, hydrofluoric acid), calcium-channel antagonists, black widow spider venom
Calcium chloride 10% (27.2 mg/mL elemental calcium)	0.6-0.8 mL/kg IV	10-30 mL IV	

Cyanide antidote kit			
Amyl nitrate	Not typically used	1 ampule in oxygen chamber of ambu-bag 30 sec on/ 30 sec off	Cyanide poisoning
Sodium nitrite (3% solution)	0.33 mL/kg IV	10 mL	Hydrogen sulfide (use only sodium nitrite)
Thiosulfate (25% solution)	1.65 mL/kg IV	50 mL IV	
Deferoxamine	Initial dose: 20 mg/kg IM/IV (15 mg/kg/h IV); 1 g max	Initial dose: 1 g IM/IV (15 mg/kg/h IV); 6 g/d max	Iron
Dextrose	0.5 g/kg IV	1 g/kg IV	Hypoglycemia

Digoxin immune Fab	(Empiric)	(Empiric)	
Acute	10-20 vials IV	10-20 vials IV	Digoxin and cardiac glycosides
Chronic	1-2 vials IV	4-6 vials IV	
Ethanol 10% for IV administration	10 mL/kg over 30 min, then 1.2 mL/kg/h ^a		Ethylene glycol, methanol
Folic acid/leucovorin	1-2 mg/kg q4-6h IV		Methotrexate (only leucovorin)
Fomepizole	15 mg/kg IV, then 10 mg/kg q12h		Methanol, ethylene glycol, disulfiram

Flumazenil	0.01 mg/kg IV	0.2 mg IV	Benzodiazepines
Glucagon	50-150 µg/kg IV	3-10 mg IV	Calcium channel blocker, β-blocker
Hydroxycobalamin (may be used with sodium thiosulfate)	70 mg/kg IV over 30 min (5 g max)	5 g IV over 30 min	Cyanide, nitroprusside
IV lipid emulsion 20%	1.5 mL/kg IV over 1 min (may repeat × 2), then 0.25 mL/kg/min IV	100 mL IV over 1 min, then 400 mL IV over 20 min	Calcium channel blocker, β-blocker (rescue therapy)
Methylene blue	1-2 mg/kg IV Neonates: 0.3-1 mg/kg	1-2 mg/kg IV	Oxidizing chemicals (eg, nitrites, benzocaine, sulfonamides)
Octreotide	1 µg/kg SC q6h	5-100 µg SC q6h	Refractory hypoglycemia after oral hypoglycemic agent ingestion
Naloxone	As much as is needed. Typical starting dose 0.01 mg/kg IV	As much as is needed. Typical starting dose 0.4-2 mg IV	Opioid, clonidine

Physostigmine	0.02 mg/kg IV	0.5-2 mg IV	Anticholinergic substances (not cyclic antidepressants)
Pralidoxime (2-PAM)	20-40 mg/kg IV, then 20 mg/kg/h	1-2 g IV, then 500 mg/h	Cholinergic substances
Protamine	1 mg neutralizes 100 U of unfractionated heparin; administered over 15 min		Heparin
	0.6 mg/kg IV (empiric)	25-50 mg IV (empiric)	
Pyridoxine	Gram for gram of ingestion if amount of isoniazid is known		Isoniazid, Gyromitra esculenta, hydrazine
	70 mg/kg IV (5 g max)	5 g IV	
Sodium bicarbonate	1-2 mEq/kg IV bolus then 2 mEq/kg/h IV		Sodium channel blockers, alkalinization of urine or serum
Thiamine	5-10 mg IV	100 mg IV	Wernicke syndrome, "wet" beri-beri
Vitamin K ₁	1-5 mg/d PO	20 mg/d PO	Anticoagulants (eg, warfarin)

HYPOGLYCEMIA

Treat hypoglycemia with IV dextrose.

Patients at risk of Wernicke's encephalopathy also require thiamin.

Supplemental oxygen, thiamine, glucose, and naloxone are often administered empirically as a cocktail in cases of altered mental status.

Altered mental status not responding to an antidote or not consistent with exposure history requires further investigation.

- Metabolic, infective, and surgical (e.g., intracranial injury) causes of altered mental status should be considered.

CARDIAC ARRHYTHMIAS

Antidysrhythmic drugs are not first-line treatment for toxin-induced dysrhythmias.

Most toxin-induced dysrhythmias respond to correction of hypoxia, metabolic/acid-base abnormalities, and administration of an antidote

(e.g., digoxin Fab).

Sodium bicarbonate is administered for sodium channel–blocker toxicity with cardiovascular complications, such as wide QRS complex tachydysrhythmias.

Ventricular tachydysrhythmias may respond to overdrive pacing.

SEIZURES

Drug-induced seizures are treated with titrated doses of IV benzodiazepines.

Isoniazid-induced seizures require pyridoxine.

Metabolic disorders can also produce seizures and should be rapidly excluded.

Propofol and barbiturates are second-line agents for benzodiazepine-resistant seizures.

There is no role for phenytoin in the treatment of toxin-induced seizures.

AGITATION

Agitation is treated with titrated doses of benzodiazepines.

Antipsychotic agents are often used as second-line agents for toxin-induced agitation.

First generation antipsychotics, such as haloperidol have been associated with QT-interval prolongation and cardiac dysrhythmias

HYPERTHERMIA & HYPOTHERMIA

Patients with core temperatures of $>39^{\circ}\text{C}$ require aggressive active cooling measures to prevent complications such as rhabdomyolysis, organ failure, and disseminated intravascular coagulation.

Sedation, neuromuscular paralysis, and intubation are required if active measures are ineffective.

Several toxidromes associated with hyperthermia are treated with specific pharmaceutical agents: sympathomimetic (benzodiazepines), serotonin (cyproheptadine), and neuromuscular malignant syndrome (bromocriptine).

HYPERTHERMIA & HYPOTHERMIA

Drug-induced coma with subsequent immobility and environmental exposure or inherent drug toxicity (opioids, phenothiazines, ethanol) may produce hypothermia.

A core temperature $<32^{\circ}\text{C}$ is an indication for active rewarming.

IV LIPID EMULSION

IV lipid emulsion should be used as part of management of cardiac arrest in bupivacaine toxicity.

Currently, IV lipid emulsion can be considered as a potential rescue therapy in life-threatening cardiotoxicity caused by lipophilic cardiotoxins that is resistant to conventional therapies.

ASSESSMENT

Risk assessment is performed to predict course of clinical toxicity, interventions required, and patient disposition.

Risk assessment is formulated using history, examination, and ancillary test results.

Acute poisoning is a dynamic process; therefore, risk assessment may change with time and requires ongoing review.

HISTORY

Patients may not provide a clear history due to psychiatric illness, clinical effects of exposure, and fear of arrest or repercussions from family or friends.

Information including identity of substances, doses, and route of exposure is crucial in formulating a risk assessment.

Obtain collateral information from family, friends, previous medical records, and usual healthcare provider.

Prehospital emergency services can provide information regarding empty medication containers or the scene environment (smells, particular materials or substances present).

EXAMINATION

TABLE 176-3

Examination of the Poisoned Patient

Organ System	Examination	Example of Finding (Possible Significance)
General	Mental state and dress Signs of injury Odors Nutritional state Vital signs	Unkempt (psychiatric illness) Scalp hematoma (intracranial injury) Malnourished (IV drug use, human immunodeficiency virus infection) Smell of bitter almonds (cyanide toxicity)
CNS	Conscious state Pupil size and reactivity Eye movements Cerebellar function/gait	Miosis (opioids, organophosphates, phenothiazines, clonidine intoxication) Nystagmus/ataxia (anticonvulsant and ethanol toxicity)

EXAMINATION

Cardiovascular	Heart rate/blood pressure Cardiac auscultation	Murmur (endocarditis/IV drug use)
Respiratory	Oxygen saturation Respiratory rate Chest auscultation	Fever/crepitations/hypoxia (aspiration pneumonia) Bronchorrhea/crepitations/hypoxia (organophosphate toxicity)
GI	Oropharynx Abdomen Bladder	Urinary retention (anticholinergic toxicity) Oral cavity burns (corrosive ingestion) Hypersalivation (cholinergic toxidrome)

EXAMINATION

Peripheral nervous	Reflexes Tone Fasciculations Tremor Clonus	Tremor/fasciculations (lithium toxicity) “Lead pipe” rigidity (neuromuscular malignant syndrome) Clonus/hyperreflexia (serotonin toxicity)
Dermal/peripheral	Bruising Cyanosis Flushing Dry/moist skin Injection sites Bullae	Bruising (coagulopathy, trauma, coma) Flushing/warm, dry skin (anticholinergic toxicity) Warm, moist skin (sympathomimetic toxicity) Bullae (prolonged coma, barbiturates)



Physical Findings Associated with Various Types Poisons.

Altered vital signs

Hypertension: amphetamines, phencyclidine, phenyl propanolamine, anticholinergics, cocaine, nicotine

Hypotension: sedative-hypnotics, narcotics, antihypertensives, theophylline, clonidine, β -blockers, tricyclic antidepressants

Hyperthermia: salicylates, amphetamines, cocaine, phencyclidine, anticholinergics, seizures due to any cause

Hypothermia: narcotics, barbiturates, ethanol, other sedative-hypnotics, clonidine, phenothiazines

Hyperpnea: salicylates or other agents causing metabolic acidosis

Ocular signs

Miosis (pinpoint pupils): narcotics, clonidine, organophosphates, phenothiazines, severe sedative-hypnotic overdose, pilocarpine

Mydriasis (dilated pupils): anticholinergics, amphetamines, cocaine, LSD, glutethimide

Nystagmus: phenytoin, phencyclidine (especially vertical nystagmus), alcohol, many sedative-hypnotics

Ophthalmoplegia: botulism, sedative-hypnotics

Oculogyric crisis: haloperidol, other antipsychotics

Optic neuritis methanol

Breath odors

Smoke: fire-associated toxins (see section on inhalants)

Garlic arsenic, arsine gas, organophosphates

Bitter almond or silver polish; cyanide

Wintergreen: methyl salicylate

Pear-like: chloral hydrate

Rotten eggs: hydrogen sulfide

Acetone: diabetic ketoacidosis, isopropanol

Typical odors of ethanol, ammonia, tobacco, disinfectants, camphor, glue, paraldehyde



Physical Findings Associated with Various Types Poisons.

Skin signs

Cyanosis: ergotamine, agents causing hypoxemia, hypotension, or methemoglobinemia

Flushed, red: carbon monoxide (rare), cyanide (rare), anticholinergics, boric acid

Acneiform rash: bromides, chlorinated aromatic hydrocarbons

Bullae: nonspecific for sedative-hypnotic overdose, carbon monoxide, and other causes of coma

Altered muscle tone

Increased: amphetamines, phencyclidine, antipsychotics

Flaccid: sedative-hypnotics, narcotics, clonidine

Fasciculations: organophosphates, lithium

Rigidity: haloperidol, phencyclidine, strychnine

Dystonic posturing: antipsychotics, phencyclidine

Tremor: lithium, nicotine, or stimulant overdose; alcohol or sedative-hypnotic withdrawal

Asterixis (flapping tremor): agents causing hepatic encephalopathy

Seizures: tricyclic antidepressants, theophylline, amphetamines, cocaine, phencyclidine, phenothiazines isoniazid, lindane, other chlorinated hydrocarbons and pesticides

DIAGNOSTIC TESTING

A serum acetaminophen concentration is a routine screening test in poisoned patients because early acetaminophen poisoning is often asymptomatic and does not have a readily identifiable toxidrome at the time when antidotal treatment is most efficacious.

An ECG is a useful test to detect cardiac conduction abnormalities and identify patients at increased risk of toxin-induced adverse cardiovascular events

Measurement of drug or toxin concentrations in body fluids is not required in most poisonings, but in some exposures, measurement of serum drug concentrations does influence management

DIAGNOSTIC TESTING

Toxicologic screening tests of urine can be done in a central laboratory or performed with point-of-care assays

Urine drug screens most often use enzyme-immunoassays to detect typical drugs within each class.

Urine drug screen results seldom influence patient management in most adult overdoses and poisoning.

DECONTAMINATION

Decontamination is required for toxic exposures affecting large dermal areas.

Healthcare providers wearing personal protective equipment or observing universal precautions (gown, gloves, eye protection) should assist with undressing and washing the patient using copious amounts of water.

Contaminated clothing is collected, bagged, and properly disposed.

Decontamination ideally occurs in a separate area adjacent to the ED, minimizing cross-contamination.

Whole-Bowel Irrigation	Polyethylene glycol 2 L/h in adults, children 25 mL/kg per hour (maximum 2 L/h)
Indications (potential)	- Iron ingestion >60 milligrams/kg with opacities on abdominal radiograph - Life-threatening ingestion of diltiazem or verapamil - Body packers or stuffers - Slow-release potassium ingestion - Lead ingestion (including paint flakes containing lead) - Symptomatic arsenic trioxide ingestion - Life-threatening ingestions of lithium
Contraindications	- Unprotected airway - GI perforation, obstruction or ileus, hemorrhage - Intractable vomiting - Cardiovascular instability
Complications	- Nausea, vomiting - Pulmonary aspiration - Time consuming; possible delay instituting other definitive care

URINARY ALKALINIZATION

Alkaline urine favors ionization of acidotic drugs within renal tubules, preventing resorption of the ionized drug back across the renal tubular epithelium and enhancing elimination through the urine.

Urinary alkalization is most effective for weak acids primarily eliminated by the renal tract that are also readily filtered at the glomerulus and have small volumes of distribution.

Hypokalemia will reduce the effectiveness of urinary alkalization.

The primary indication for urinary alkalization is moderate to severe salicylate toxicity when criteria for hemodialysis have not been met.

URINARY ALKALINIZATION

Although urinary acidification can enhance the elimination of weak bases including amphetamines and phencyclidine, associated risks (e.g., rhabdomyolysis) outweigh potential benefit.

Forced diuresis has no indication for any poisoning, with the exception of chlorophenoxy herbicides

Urinary Alkalinization	
Indications	Moderate to severe salicylate toxicity not meeting criteria for hemodialysis Phenobarbital (multidose activated charcoal superior) Chlorophenoxy herbicides (2-4-dichlorophenoxyacetic acid and mecoprop): requires high urine flow rate of 600 mL/h to be effective Chlorpropamide: supportive care/IV dextrose normally sufficient
Contraindications	Preexisting fluid overload Renal impairment Uncorrected hypokalemia
Complications	Hypokalemia Volume overload Alkalemia Hypocalcemia (usually mild)

TABLE 176-10**Protocol for Urinary Alkalinization in Adults With Normal Renal Function**

- Correct existing hypokalemia.
- Administer a 1 to 2 mEq/kg IV sodium bicarbonate bolus.
- Infuse 100 mEq of sodium bicarbonate mixed with 1 L of D₅W at 250 mL/h.
- 20 mEq of potassium chloride may be added to the solution to maintain normokalemia.
- Monitor serum potassium and bicarbonate every 2–4 h to detect hypokalemia or excessive serum alkalinization.
- Check urine pH regularly (every 15–30 min); goal is a pH of 7.5–8.5.
- A further IV bolus of 1 mEq/kg of sodium bicarbonate may be necessary if sufficient alkalinization of the urine is not achieved.

TABLE 176-11

Indications, Contraindications, and Complications of Extracorporeal Removal Techniques

Hemodialysis	Movement of solute down a concentration gradient across a semipermeable membrane
Toxin requirements	Low volume of distribution, low protein binding, low endogenous clearance, low molecular weight
Indications	Life-threatening poisoning by: Lithium Phenobarbital Salicylates Valproic acid Methanol/ethylene glycol Metformin-induced lactic acidosis Potassium salts Theophylline
Contraindications	Hemodynamic instability Infants (generally) Poor vascular access Significant coagulopathy

Hemoperfusion	Movement of toxin from blood, plasma, or plasma proteins onto a bed of activated charcoal (or other adsorbent)
Toxin requirements	Low volume of distribution, low endogenous clearance, bound by activated charcoal
Indications	Life-threatening poisoning caused by: Theophylline (high-flux hemodialysis is an alternative) Carbamazepine (multidose activated charcoal or high-efficiency hemodialysis also effective) Paraquat (theoretical benefit only if instituted early after exposure)
Contraindications	Hemodynamic instability Infants (generally) Poor vascular access Significant coagulopathy Toxin not bound to activated charcoal

DISPOSITION

Admission is indicated if the patient has persistent and/or severe toxic effects or will require a prolonged course of treatment.

In most cases, a 6-hour observation period is sufficient to exclude the development of serious toxicity.

Onset of clinical toxicity can be delayed after a number of exposures, including modified-release preparations of calcium channel blockers, selective norepinephrine reuptake inhibitors (tramadol, venlafaxine), and newer antipsychotics (amisulpride); hence, a period of extended observation is indicated.

patients can be efficiently and safely managed in a toxicology or short-stay ward, if available.

DISPOSITION

Patients who have deliberately self-poisoned require appropriate mental health assessment before disposition.

Acetaminophen Poisoning

A disorder characterized by hepatic necrosis following large ingestions of acetaminophen.

Symptoms may vary from initial nausea, vomiting, diaphoresis, and malaise to jaundice, confusion, somnolence, coma, and death.

The clinical hallmark is the onset of symptoms within 24 hours of ingestion of acetaminophen-only or combination products. Ideally, ingestion is treated before symptoms develop.

Acetaminophen Poisoning

Toxic exposure to APAP is likely when

- Patient >6 years old ingests either:
 - >10 g or 200 mg/kg in a single ingestion or over a 24-hour period,
 - >6 g or 150 mg/kg/d for two consecutive days.
- For children <6 years old, either:
 - >200 mg/kg in a single ingestion or over an 8-hour period,
 - 150 mg/kg/day for two consecutive days would be considered toxic.

Acetaminophen Poisoning

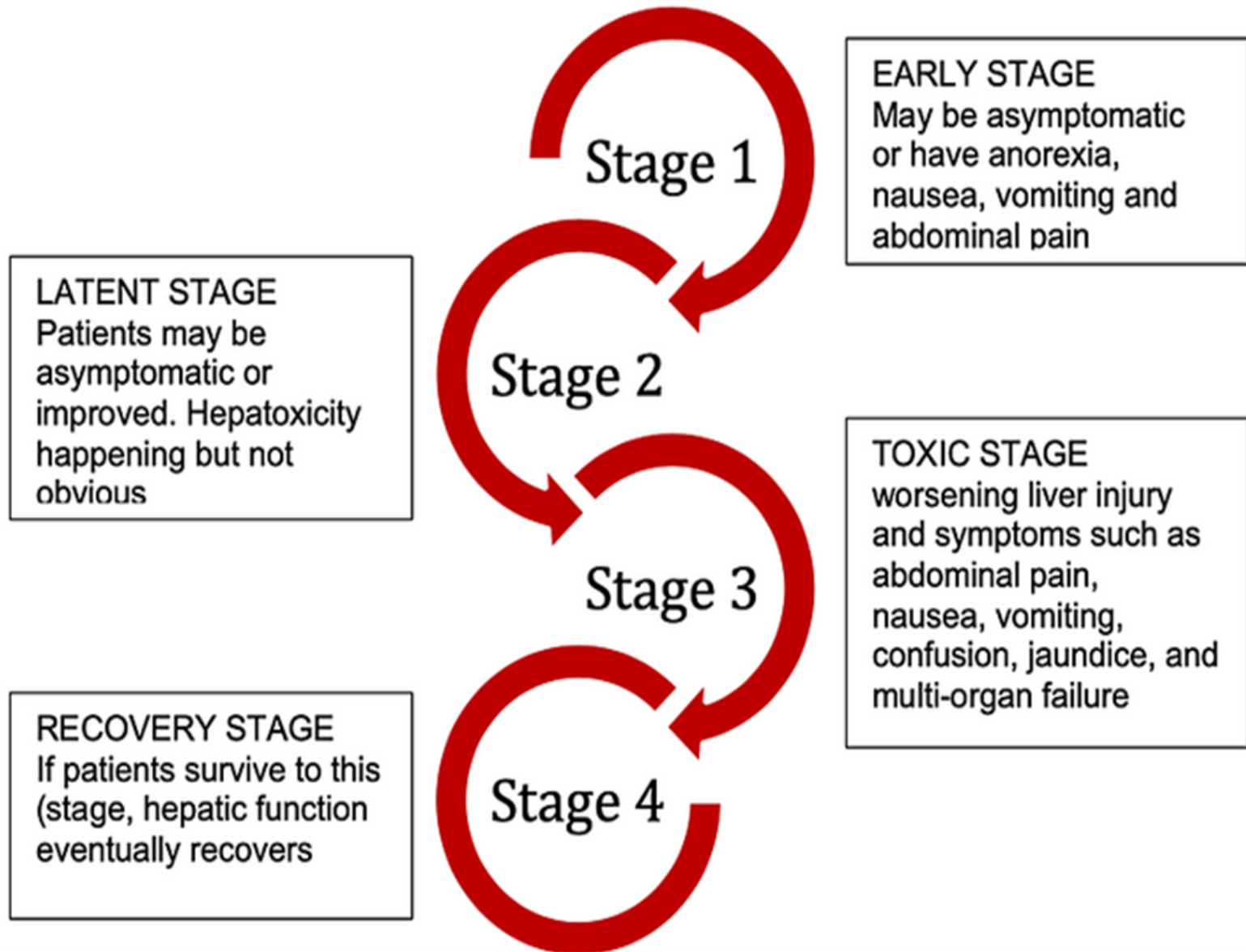
Acute APAP toxicity can present in four classic stages .

Level greater than 150 -200 mcg/mL at 4 hours from ingestion is considered toxic

Massive APAP ingestions (4-hour APAP level >800 micrograms/mL) may cause early coma or agitation and lactic acidosis, as opposed to delayed symptom onset seen in the majority of APAP overdoses.



Acetaminophen Poisoning



Acetaminophen Poisoning

Phases of Acetaminophen Toxicity

PHASE*	ONSET	CLINICAL CHARACTERISTICS	LABORATORY FINDINGS
I	<24 hours	Anorexia, nausea, vomiting, diaphoresis (patient may be asymptomatic)	Toxic acetaminophen level
II	24-72 hours	Right upper quadrant abdominal pain	Mild elevation in LFTs
III	3-5 days	Vomiting, jaundice, encephalopathy, oliguria	Marked elevation in LFTs, coagulopathy, azotemia, hypoglycemia, hypophosphatemia
IV	About 1 week	Gradual resolution of toxicity	Improvement in laboratory values

Acetaminophen Poisoning

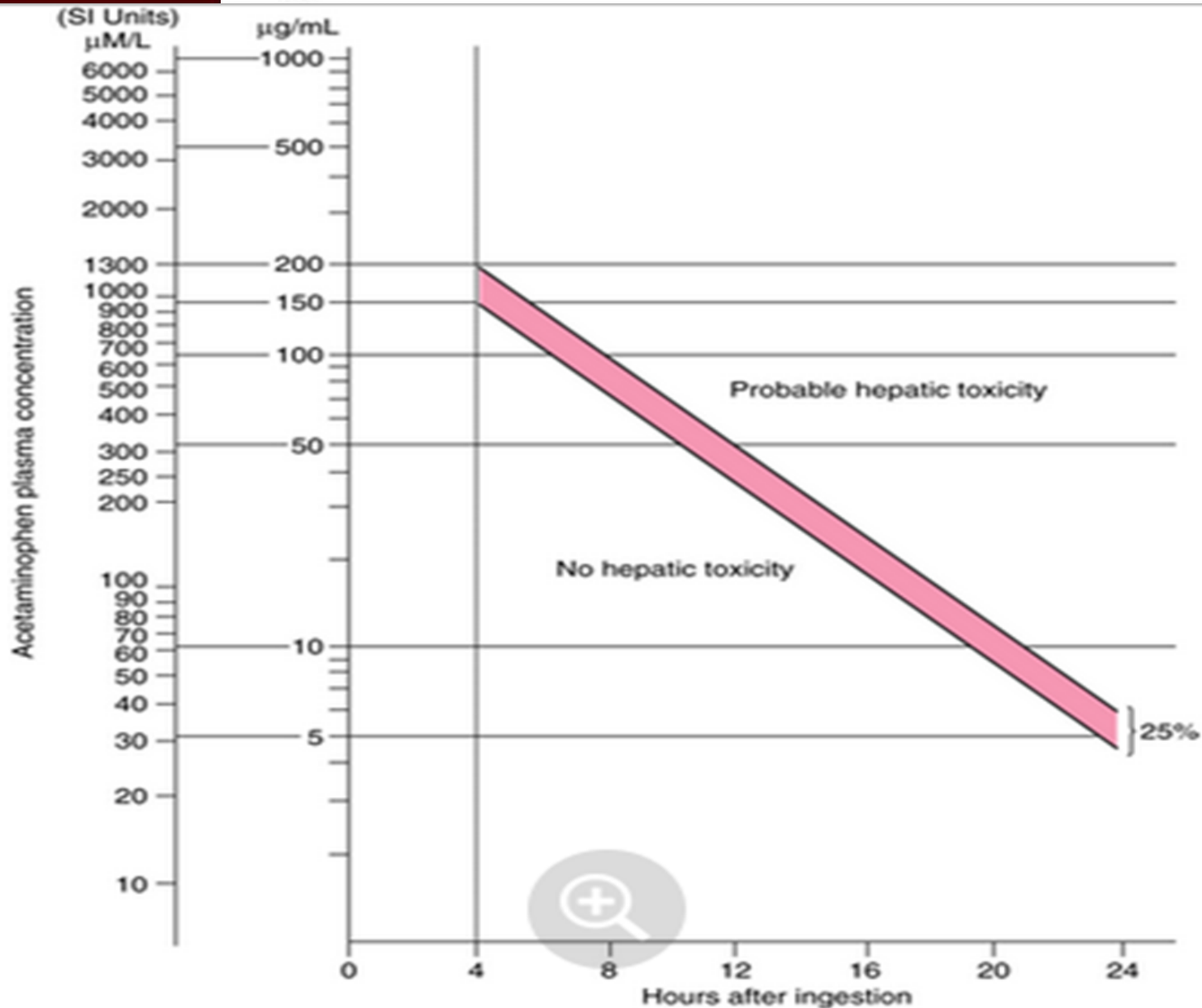
An acute ingestion of 7.5 g or 150 mg/kg is generally predictive of hepatotoxicity.

The most accurate predictor of hepatotoxicity is the serum acetaminophen level obtained between 4 and 24 hours after acute ingestion.

The Rumack-Matthew nomogram, which plots serum concentration against hours postingestion, is the standard reference for predicting hepatotoxicity in an acute overdose.

If the initial level is close to the treatment line on the nomogram, consider checking another level in 2 hours

Rumack-Matthew nomogram



Acetaminophen Poisoning

96% of ingested acetaminophen is metabolized in the liver, with only 2-4% excreted unchanged in the urine. When taken in therapeutic doses, 90-95% of hepatic metabolism occurs via glucuronidation and sulfation and results in the formation of benign metabolites.

5-10% of hepatic metabolism is by oxidation through the cytochrome P₄₅₀ enzyme system (CYP3A4 and CYP 2E1), which results in the formation of the toxic metabolite N-acetyl-p-benzoquinoneimine (NAPQI).

NAPQI is rapidly conjugated with glutathione to form a nontoxic metabolite.

Acetaminophen Poisoning

The metabolites are excreted in the urine along with a small amount of unchanged drug.

Hepatocellular damage typically occurs when toxic doses of acetaminophen result in saturation of the glucuronidation and sulfation pathways.

Available glutathione stores become depleted, and hepatocellular damage occurs.

Initial Tests

Plasma acetaminophen levels should be drawn on all patients ≥ 4 hours after ingestion (levels prior to 4 hours not helpful).

ALT, AST, PT/NR, bilirubin, LDH

Electrolytes, glucose, BUN, creatinine

Urinalysis

Consider arterial blood gas (ABG) if pH disturbance is suspected on clinical or lab grounds.

Initial Tests

Screens for suspected coingestants (aspirin, iron, etc.) may be positive (especially when suicide attempt is a possibility).

With toxic ingestions, AST, ALT; and bilirubin levels begin to rise in stage 2 and peak in stage 3.

In severe poisonings, PT/INR will parallel these changes and should be monitored.

Markedly elevated ALT levels are consistent with the diagnosis, and improvement in ALT is a good sign.

Laboratory abnormalities usually resolve by stage 4.

Initial Tests

Renal function abnormalities are common in patients with hepatotoxicity. Evidence of damage to pancreas and heart may present following severe poisonings.

Anion-gap metabolic acidosis may rarely be seen.

TREATMENT

Acetylcysteine (NAC, Mucomyst) should be initiated within 8 hours of ingestion whenever possible; single-dose activated charcoal (1 g/kg PO) may be effective if given within 1 hour of ingestion. Never delay oral NAC for activated charcoal.

Acetylcysteine may be given PO or IV, depending on situation and availability:

- IV loading dose of Acetadote 150 mg/kg over 60 minutes followed by an infusion of 50 mg/kg over 4 hours (12.5 mg/kg/hr); this is followed by an infusion of 100 mg/kg over the next 16 hours (6.25 mg/kg/hr) (20-hour regimen)
- Oral loading dose of 140 mg/kg, followed by 70 mg/kg q4h for 17 additional doses (72-hour regimen)



Emergency

Thank you

