General Poisoning Management

14

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A 24-year-old lady was admitted to the hospital, with history of consumption of some liquid at home followed by vomiting, altered mental status, and labored breathing. She was brought to the triage in the comatose state with pinpoint pupils, frothy secretions from her mouth, heart rate 58/min, and blood pressure 90/48 mmHg.

High index of suspicion for intoxication is warranted in the practice of critical care medicine particularly for patients admitted with unexplained altered mental status, seizures, cardiac dysrrhythmias, and respiratory depression. Diagnosis may be complicated by the possibility of a multiple-drug ingestion. Supportive care during first few hours of admission may be lifesaving. Antidotes should be used early on suspicion of a particular poison to prevent organ dysfunction. Attempts to identify the toxin should be done by focused history, a directed physical examination, and commonly available laboratory tests.

Step 1: Initiate Resuscitation and Assessment

- Initiate resuscitation as mentioned in Chap. 23, Vol. 2

Airway

- Management of airways is very important in poisoning. Some toxins (acid or alkali ingestion) require extra care during airway management. When

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intubation is necessary, rapid sequence induction is indicated using short-acting paralytic agents.
- Urine toxicology screening should be obtained before any sedatives or hypnotics are administered.

Breathing

- A patient's oxygenation status can be monitored with a bedside pulse oximeter except toxins leading to dyshaemoglobenemias i.e. in carbon monoxide poisoning, pulse oximeter is unreliable in detecting carboxyhemoglobin. Similarly in methemglobinaemia due to cyanide poisoning pulse oximetry saturation is not reliable. In these cases true oxygen saturation can be measured by coximeter enabled blood gas analyser.
- Some newer generation pulse oximeters are capable of estimating carboxy and methemoglobin continuously by adding additional light emitting diodes of different wavelengths.
- Give oxygen by the nasal cannula or face mask to maintain SpO_2 more than 95%.
- When the patient is in respiratory distress and not able to maintain oxygenation or ventilation, assisted ventilation should be considered.

Circulation

- Monitor pulse and blood pressure. Do an ECG. Obtain a good peripheral line and start intravenous fluids.
- The "coma cocktail" of dextrose (50 ml D50W IV), naloxone (2 mg IV), flumazenil (0.2 mg IV), and thiamine (100 mg IV) can be considered in unknown poisoning with unconsciousness and coma but should be avoided in patients with history of benzodiazepines or opiates abuse as seizures or arrhythmias may be precipitated.

Step 2: Take Detailed History

- Detailed and targeted history from the family members and friends including the past medical treatment and occupational environment is important for making the diagnosis of poisoning.
- The history should include the type of toxin or toxins, time of exposure (acute versus chronic), amount taken, and route of administration (i.e., ingestion, intravenous, and inhalation).
- The patient should be asked about over-the-counter medications, vitamins, and herbal preparations.
- The patient or accompanying attendants should be asked about all drugs taken, including prescription drugs and empty bottles/containers, and the physician can also perform "pill count" to ascertain the number of consumed pills.

Table 14.1 Physiologic grading of the severity of poisoning—signs and symptoms

Severity	Stimulant poisoning	Depressant poisoning
Grade 1	Agitation, anxiety, diaphoresis, hyperreflexia, mydriasis, tremors	Ataxia, confusion, lethargy, weakness, able to follow verbal commands
Grade 2	Confusion, fever, hyperactivity, hypertension, tachycardia, tachypnea	Mild coma (nonverbal but responsive to pain); brainstem and deep tendon reflexes intact
Grade 3	Delirium, hallucinations, hyperpyrexia, tachyarrhythmias	Moderate coma (respiratory depression, unresponsive to pain); some but not all reflexes absent
Grade 4	Coma, cardiovascular collapse, seizures	Deep coma (apnea, cardiovascular depression); all reflexes absent

- Remember the history from the patient may not always be reliable.
- The clinical diagnosis of the type of poisoning can be identified by the clinical manifestations that may fit into a particular toxidrome. Toxic overdose can present with a wide array of symptoms, including abdominal pain, vomiting, tremor, altered mental status, seizures, cardiac dysrrhythmias, and respiratory depression, which may be the only clues to diagnosis (Table 14.1).
- Symptoms are often nonspecific (as in early acetaminophen poisoning) or masked by other conditions (e.g., myocardial ischemia in the setting of carbon monoxide poisoning).

Step 3: Perform Physical Examination

- The patient stabilization will take precedence over the detailed physical examination.
- Once the patient is stable, a more comprehensive physical and systemic examination should be performed.
- Serial examinations are even more important to assess dynamic change in clinical appearance. The systematic neurological evaluation is particularly important in patients with altered mental status. Alert/verbal/painful/unresponsive scale (AVPU) is a simple, rapid method of assessing consciousness in most poisoned patients.
- Focussed clinical examination e.g. characteristic odors of some poisoning (Garlic in OrganoPhosphorus [OP] poisoning), Pupillary findings, Movement disorders like seizures, skin findings (flushed or pale, dry or warm) Temperature alteration (hypo or hyperthermia), Respiratory alteration, etc. can help in differentiating types of poisoning
- Look for features of associated trauma or injury during intoxication

Step 4: Order Investigations

A basic metabolic panel should be obtained in all poisoned patients:

- Complete blood count
- Serum electrolytes
- Blood urea nitrogen and creatinine
- Blood glucose and bicarbonate level
- Liver functions test
- coagulation profile
- Arterial blood gases
- ECG
- If the patient is a female of child-bearing age, a pregnancy test is essential.
- The anion gap, serum osmolality, and osmolal gap should be measured in each patient as it can help in finding the cause (Table 14.2).
- Chest and plain abdominal X-ray should be done if high index of suspicion of radiopaque pills, drug- filled packets i.e. cocaine, enteric coated tablets, heavy metals etc.

Specific investigations:

- Sample for urine toxicology screening for common drugs must be taken before giving any sort of sedation to these patients.
- The cholinesterase level for organophosphorus poisoning: Specific levels of cholinesterase can guide treatment.
- Paracetamol, Salicylate and other drug levels where appropriate

Table 14.2 Common causes of abnormal anion gap

Elevated anion gap	Decreased anion gap	Increased osmolar gap
Lactic acidosis (type A)	Increased unmeasured cation	Methanol and ethylene glycol
Uremia	Hyperkalemia	Diabetic ketoacidosis
Sepsis	Hypercalcemia	Isopropyl alcohol (acetone)
Rhabdomyolysis	Hypermagnesemia	Ethanol
Ketoacidosis: diabetic, starvation, ethanol	Acute lithium intoxication	
	Elevated IgG (myeloma cationic paraprotein)	
	Unmeasured decreased anion	
	Hypoalbuminemia	
Toxic ingestions	Drugs	
Ethylene glycol	Bromide	
Methanol	Iodide	
Paraldehyde	Lithium	
Salicylate	Polymyxin B	
	Analytical artifact	
	Hypernatremia	
	Hyperlipidemia	

- Oxygen saturation gap (SaO_2–SpO_2): An oxygen saturation gap is present when there is more than a 5% difference between the measured **oxygen saturation** from a standard blood gas machine with cooximeter and the reading from a pulse oximeter. If it is greater than 5%, the patient's hemoglobin may be abnormal, representing carbon monoxide poisoning (carboxyhemoglobin), methemoglobinemia (Cyanide, Dapsone), or sulfhemoglobinemia (Hydrogen sulfide).

Step 5: Admit to the ICU

Admit in ICU if any of the following is present:

- Respiratory depression ($PaCO_2$ > 45 mmHg)
- Emergency intubation
- Seizures
- Cardiac arrhythmia (QT prolongation, preferably corrected QTc)
- QRS duration more than 0.12 s
- Second- or third-degree atrioventricular block
- Systolic BP less than 80 mmHg
- Unresponsiveness to verbal stimuli
- Glasgow coma scale score less than 12
- Need for emergency dialysis, hemoperfusion, or extracorporeal membrane oxygenation
- Increasing metabolic acidosis
- Pulmonary edema induced by toxins (including inhalation) or drugs
- Tricyclic or phenothiazine overdose manifesting anticholinergic signs, neurologic abnormalities, QRS duration more than 0.12 s, or QT more than 0.5 s
- Administration of pralidoxime in organophosphate toxicity
- Antivenom administration in envenomation
- Need for continuous infusion of naloxone

Step 6: Management

- The management of any clinically significant poisoning should begin with basic supportive measures. The first priority after airway, breathing, and circulation approach is to prevent and manage life-threatening complications.

Step 7: Decontamination

- The clothing should be removed in suspected or confirmed dermal exposures, and the skin should be copiously irrigated and washed with a mild soap and water in organophosphorus poisoning.

- The eye should be copiously irrigated with water in ocular exposure to acids and alkali.
- Gastric lavage: The place of gastric lavage in acute poisoning is debatable and is only of benefit in the hyperacute phase of poisoning (<1 h). Caution: Patients must be awake with a preserved gag reflex.
- Charcoal: Charcoal aspiration has a high morbidity and mortality. This should not be attempted in patients without a safe or protected airway.
- Administer 50-g charcoal as soon as possible and another 50 g every 4 h thereafter while indication persists. Coadministration with sorbitol has not been shown to increase efficacy.
- Charcoal administration is most effective when it is given within 1 h of ingestion.
- Contraindications to charcoal administration are as follows:
  - Elemental metals (lithium, iron)
  - Pesticides
  - Strong acids or alkalis
  - Cyanide
  - Late presentations (>4–6 h post-ingestion)

Step 8: Enhance Elimination

- Alkalinization of urine may help in excretion of drug in the urine in poisonings such as salicylates, phenobarbital, and chlorpropamide.
- Dialysis and charcoal hemoperfusion should be considered in severe poisoning if the toxin can be removed by dialysis (Table 14.3).
- Plasmapheresis has also been tried for removal of certain poisons (Table 14.3).
- Other therapies like extra corporeal membrane oxygenation (ECMO) for cardiac and pulmonary support has also been tried in several patients with acute poisoning (Table 14.3).

Table 14.3 Indication of Extracorporeal Support, dialysis and hemoperfusion

Hemodialysis	Hemoperfusion	Plasmapheresis	ECMO
Methanol	Theophylline	Tricyclic antidepressants	Amiodarone
Ethylene glycol	Phenobarbital	Thyroxine	Beta-blocker
Boric acid	Phenytoin	Heavy metals	Calcium channel blockers
Salicylates	Carbamazepine	Theophylline	Opioids
Lithium	Paraquat		Organophosphorous
	Glutethimide		Paraquat
			Tricyclic antidepressants

Table 14.4 Common poisons and their antidotes

Poison	Antidote
Acetaminophen	*N*-Acetylcysteine
Anticholinergics	Physostigmine
Anticoagulants (warfarin/coumadin, heparin)	Vitamin K, protamine respectively
Dabigatran	Idarucizumab (Praxbind)
Rivoroxaban, Apixaban	Andenaxet Alfa
Benzodiazepines	Supportive care, flumazenil[a]
Botulism	Botulinum antitoxin
β-Blockers	Glucagon
Calcium channel blockers	Calcium, glucagon
Cholinergics (i.e., organophosphorus)	Atropine, pralidoxime
Carbon monoxide	Oxygen, hyperbaric oxygen
Cyanide	Amyl nitrate, sodium nitrate, sodium thiosulfate, hydroxocobalamin (
Digoxin	Digoxin Fab antibodies
Iron	Deferrioxamine
Isoniazid	Pyridoxine
Lead	BAL, EDTA, DMSA
Methemoglobinemia	Methylene blue
Opioids	Naloxone
Toxic alcohols	Ethanol drip, dialysis Fomepizole
Tricyclic antidepressants	Sodium bicarbonate

[a]Use of flumazenil should be contraindicated in many situations including tricyclic overdose or in chronically habituated benzodiazepine users, as this may precipitate seizures

Step 9: Use Antidotes to Common Poisons

- Antidotes should be used early in the course in which the effects of poisoning can be counteracted (Table 14.4).

Step 10: Other Measures

Intravenous Fat Emulsion (IFE) has been suggested as a probably beneficial therapy in the management of local anesthetic overdose. e.g. Bupivacaine, mepivacaine, ropivacaine, levobupivacaine, prilocaine, lignocaine, lidocaine It has also been tried in several other poisoning, with varied results (Table 14.5). Although the exact mechanism of its action is unknown, it is postulated to mediate antidote activity or act by compartmentalization of the offending agent into lipid phase, and hence moving it away from its target receptors. As per the current dosing recommendations, a bolus of 1.5 mL/kg, followed by an intravenous infusion at the rate of 0.25 mL/kg/min should be initiated.

Table 14.5 Drugs which may benefit by use of intravenous fat emulsion

Probable benefit
All local anesthetics: Bupivacaine, mepivacaine, ropivacaine, levobupivacaine, prilocaine, lignocaine, lidocaine
Possible benefit
Anti-epileptics: Carbamazepine, lamotrigine
Anti-psychotics: Chlorpromazine, haloperidol, olanzapine, quetiapine
Anti-histamine: Diphenhydramine
Barbiturates: Pentobarbital, phenobarbital, thiopental
Beta-blockers: Atenolol, carvedilol, metoprolol, nevibilol, propranolol
Calcium channel blockers: Amlodipine, diltiazem, felodipine, nifedipine, verapamil
Disease-modifying anti-rheumatic drug: Hydroxychloroquine
Tricyclic antidepressants: Amitriptyline, clomipramine, dosulepin, dothiepin, doxepin, imipramine
Other anti-depressants: bupropion, venlafaxine
Others: Baclofen, cocaine, endosulfan, flecainide, propafenone

Step 11: Whenever in Doubt Seek Help from National Poison Information Centre (AIIMS)

Suggested Reading

American College of Medical Toxicology. ACMT position statement: interim guidance for the use of lipid resuscitation therapy. J Med Toxicol. 2011;7:81–2. *A statement on the use of lipids in poisionings*

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