(/microsites/cdem)

Poisonings

- Written By: Lorraine Thibodeau, MD, Albany Medical Center, Albany, New York
- Edited By: Emily Senecal, MD, Harvard Medical School, Boston Massachusetts
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Introduction

> *A 19 year old male is brought in to the emergency department via ambulance after his friends found him confused and appearing intoxicated. His friend tells you that the patient was in a fight with his girlfriend and that he was really upset. His vital sings are:*
>
> *BP = 110/80, P = 140, RR = 38, T = 98.7F, O2 sat = 98% on room air.*

An estimated 5 million accidental and intentional poisonings occur in the US each year, though the true incidence is unknown due to under diagnosis and underreporting.

Patients who have been poisoned may present with a wide array of symptoms or complaints. Some may be completely asymptomatic but state they have taken an overdose. Some may have altered mental status. Some may be unstable or apneic. Additionally, poisoned patients may present in stable condition and rapidly deteriorate.

Objectives

Upon completion of this self-study module, you should be able to:

- List the key elements of history and physical exam in an overdose patient.
- Explain the uses and limits of laboratory testing in the setting of an overdose.
- List the types of decontamination used in poisonings and specific contraindications for their use.
- Describe the classic toxidromes including anticholinergic, sympathomimetic, cholinergic, and opioid overdose.

Initial Actions

As you're walking toward her room, what actions should you take upon arriving?

- Assess the primary survey
- Order an EKG
- Order a safety companion or standard suicide precautions

Primary Survey

As with all patients, the initial survey begins with the ABC's. If the patient is unstable, then the history and physical must be performed while simultaneously performing resuscitation.

Depending on the ingestions, a poisoned patient may present obtunded. An unresponsive patient has lost his or her airway reflexes and is at risk for airway obstruction as well as aspiration. Faced with an unresponsive patient with a history of overdose, one must think of a few reversible possibilities while preparing to control the patient's airway. These reversible causes have been come to be known as the "coma cocktail." In this setting, the following should be considered:

- Hypoxia: Place on 100% O2 nonrebreather (also useful prior to intubation)

- Hypoglycemia: obtain a point of care fingerstick blood glucose
- Opioids: administer Narcan 0.4 to 2mg IV to reverse opiates
- With an unresponsive patient, if these measures do not reverse the patient's symptoms, then intubation should be performed.

Once the airway is controlled, attention may turn to breathing. Many toxins can affect the respiratory status and cause a variety of symptoms including frank respiratory failure, hypoxia, flash pulmonary edema, and bronchospasm. These should all be treated with standard therapies and in some cases specific antidotes.

Circulation can be compromised as well. A multitude of toxins can affect hemodynamics including heart rate and blood pressure (hyper or hypotension) as well as cardiac rhythm and intervals. Each of these symptoms can give a clue to what toxin has been ingested. Many agents cause tachycardia, beta blockers and calcium channel blockers can cause bradycardia, TCA's can cause QRS widening, and many cause QT prolongation.

If the patient is completely asymptomatic, there is time to obtain a more detailed history and perform a physical exam.

In all cases, there are essential elements that are important to elicit on history if possible.

Secondary Survey

Key Historical Data

In all cases, there are important questions to ask:

- What was ingested?
- How much was ingested?
- When was ingested?
- Why? (accidental or intentional)?

To answer these questions, the provider can ask the patient, family, friends and EMS. Pill bottles can be of great help if available. Reliable and accurate information may be difficult to obtain. The patient may purposely try to mislead the physician, or the patient may accidentally misname the agent ingested. For instance, some laypeople call any over-the-counter pain reliever by a single name regardless of actual name and drug class. When the circumstances of the overdose are not clear, intentional overdose should be suspected and suicide precautions instituted until more information is available.

Key Elements of Physical Exam

On the physical exam, there are a number of things to pay close attention to in addition to the standard exam:

- Vital Signs (there is a reason they are called “vital signs”)
- Mental status (agitated, confused, somnolent?)
- Pupils
- Skin color
- Track marks/skin poppers
- Presence of sweat
- Bladder size (urinary retention)

Some poisonings will cause tachycardia (sympathomimetics, anticholinergics), bradycardia, apnea, hypotension, etc. Some toxins also cause mydriasis or miosis, flushed skin, sweating, diaphoresis, or lack of sweat when expected. All of these signs offer clues to the diagnosis.

> *Though he initially appeared intoxicated, he deteriorates during your exam. He becomes unresponsive to stimuli. You intubate him easily, confirm tube placement, and finish your exam. His pupils are 4mm and reactive. His skin is not flushed. His heart is tachycardic but regular, and the rest of his exam is relatively unremarkable. There are no signs of trauma.*

Toxidromes

While looking for clues to aide in the diagnosis, there are a few classic “doorway diagnoses” where “toxidromes” are easily recognizable. These classic presentations are ccalled Toxidromes (see below).

Anticholinergic

A young college student is brought in by her friends after being found confused at a party. Her friends tell you that she was just dumped by her boyfriend. Her vitals are as follows: Pulse 122, Respiratory rate 18, Blood Pressure 120/80, Temp 100.8F, Sat 98% on room air. She is mumbling and picking at her clothes. On exam, her pupils are 8mm and her skin is flushed but she is not sweating and her bladder is full.

This is the classic anticholinergic syndrome:

- Mad as a hatter (Altered mental status)
- Blind as a bat (mydriasis)
- Hot as Hades
- Red as a beat
- Dry as a bone

Patients with an anticholinergic toxidrome may present with some or all of these findings. Possible toxins with anticholinergic properties include the following:

- TCA's Tricyclic antidepressants
- Antihistamines
- Overactive bladder medication

Treatment is mostly supportive. Please see specific therapies for TCA ingestions

Cholinergic

A migrant worker is found wandering on a deserted road. He is confused, sweating and wheezing. You notice that he has been incontinent. His vitals are as follows: Pulse 36, respiratory rate 24, Blood pressure 100/68, Temp 98F, Sat 96% on room air.

This is the classic mnemonic SLUDGE:

- Salivation
- Lacrimation
- Urination
- Diaphoresis and defecation
- Gastrointestinal upset

- Excessive bradycardia or tachycardia (muscarinic or nicotinic)

Sources of cholinergic poisoning include organophosphate poisoning (pesticides) and nerve agents

Treatment: Atropine, pralidoxime, decontaminate

Sympathomimetic

A young college student is brought in by EMS after becoming combative at a concert. He is very agitated and altered and requires restraints. His vitals are as follows: pulse 138, respiratory rate 24, blood pressure 154/92, Temp 101.2, Sat 98% on room air. Physical Exam reveals mydriasis, flushed skin, sweating and agitation.

This is the classic sympathomimetic syndrome with a fight or flight picture:

- Tachycardia
- Hypertension
- Mydriasis
- Diaphoresis
- Hyperthermia
- Agitation

Sources include nonprescription sympathomimetic agents include the over-the-counter cold agents (containing ephedrine), illegal street drugs (eg, cocaine, amphetamines, methamphetamine), dietary supplements (ephedra), and illicit designer drugs (eg, 3,4-methylenedioxy methamphetamine (MDMA, “ecstasy”)

Treatment involves sedation, hydration, and treatment of complications such as rhabdomyalysis and hyperthermia.

Opioid

Friends bring in a young man who is apneic and unresponsive. They tell you they were just partying a little and their friend collapsed. His vitals are as follows: pulse 128, Respiratory rate 4, blood pressure 100/70, temp 98F and sat 82% on room air.

Classic signs:

- Apnea
- Hypoxia
- Unresponsiveness
- Flash pulmonary edema (rare)

Treatment:These patients are usually apneic and may appear to require intubation. Administration of Nalaxone can reverse the apnea and obviate the need for intubation.

A word on Naloxone. The Naloxone will wear off before the opiate so the patient can NOT be discharged without a period of observation. Administration of Naloxone may cause the patient to go into opiate withdrawal, so be prepared for a very violent and combative response and use only the dose necessary to return a normal respiratory rate.

Diagnostic Testing

Toxicology is one of the last areas of medicine where a keen mind and good diagnostic skills are still imperative without the benefit of advanced testing and technology to provide answers. Nonetheless, there are still important tests to perform:

- EKG: may show changes in QRS or QT intervals, terminal R waves, dysrhythmias, or other findings that can help diagnose the toxin and help with treatment.
- Tox Screen: is mandatory, but often of limited value. It is institution dependent. It is often not quantitative and usually only tests for a few toxins.
- Tylenol and aspirin: One of the most important substances in the tox screen is the acetominiphen level. Unlike other toxic ingestions, acute acetaminophen overdose can present asymptomatic and can be missed if not tested.
- Electrolytes: Many toxins will produce abnormalities in electrolytes (for instance MUDPILES for metabolic acidosis)
- Levels (specific to medication)
- Others (dependent on situation)
    - Anion Gap Metabolic Acidosis: There are several causes of an anion gap metabolic acidosis, and many of them involve poisonings. The mnemonic MUDPILES is still used today to help diagnose patients. The presence of an anion gap acidosis can be useful in the diagnosis of a specific ingestions.
        - M = Methanol
        - U = Uremia
        - D = DKA or AKA

- P = Paraldehyde
- I = Iron, Isoniazid
- L = Lactate (many causes including carbon monoxide, sepsis, blood loss?)
- E = Ethylene Glycol
- S = Salicylates

So How Do I Make the Diagnosis

With suspected overdoses in the emergency department, there are rarely perfect tests to provide exact answers. The "toxicology screen" is often not quantitative and usually only tests for a few specific toxins. Always obtain an acetaminophen level and other levels as well depending on the suspected toxin. There are certain poisonings where the presence of an anion gap metabolic acidosis is key to helping diagnose the cause (see Metabolic Acidosis).

Focus on key elements of history – if possible illicit what agent was ingested, when this occurred, and how much was ingested.

Look for clues in the physical exam – look at vitals, pupil size, skin color and moisture, and overall mental status.

Use accessory data. Though it may not reveal the answer, use the Toxicology screen as well as electrolytes to aide in the diagnosis.

Be Suspicious

If the patient is asymptomatic for 4 – 6 hours and the work up is negative, they may not have taken a toxic ingestion. If the patient has findings, the provider must use all available information gathered to arrive at the most likely diagnosis and disposition the patient appropriately.

> *He doesn't appear to have a Toxidrome.*
>
> *His EKG shows Sinus Tachycardia with normal intervals.*
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> *You send a full set of labs including an ABG, CBC, full metabolic panel, and a tox screen. You order a urine as well.*

Treatment

As with all patients, treatment begins with the ABC's. The treatment of poisoned patients in particular also includes removing them from the toxin and decontaminating them when possible.

Decontamination Methods

- Activated Charcoal
- Whole Bowel Irrigation
- Gastric Lavage (rare)

Activated Charcoal is given orally to absorb toxins that are present in the GI tract. It is most efficacious if given within the first hour post ingestion but still works beyond that point. Toxins bind to the charcoal and are excreted without being digested. Charcoal does not bind metals (such as iron), alcohols or hydrocarbons. It should be avoided in patients with somnolence as they run the risk of aspiration

Whole bowel irrigation involves the administration of an osmotically balanced polyethylene glycol electrolyte solution (like Go Lytely) to flush the bowel to prevent the absorption of ingested toxins. It is used in cases where charcoal is not effective, with certain sustained release products, and in cases of illicit drug packet ingestions (body packers).

Gastric Lavage is rarely used and carries significant risks with questionable benefit. In some cases, however, such as recently ingest lethal substances or an intubated overdose following recent ingestion, the benefits may outway the risks and warrant use. Lavage involves the application of a very large bore (36 – 40 French) orogastric tube and then flushing the stomach with aliquots of water ideally to obtain pill fragments.

Note: Many years ago, there was an agent called Ipecac that was universally promoted as a decontamination method. This agent should not be used for many reasons. First, it is not effective in removing toxin. Moreover, it has side effects that can cause lethargy and can delay the administration or reduce the effectiveness of other more useful decontamination methods as well as treatments.

Disposition

Many patients with potential ingestions may be observed for six hours and then dispositioned (home or psychiatric treatment facility) if clinically asymptomatic (provided the ingestion is not an extended release agent).

Other Specific Poisonings

Acetaminophen

Acetaminophen (APAP) overdose is one of the most common but also one of the most dangerous poisonings in the US. Acetaminophen is available in many formulations and is though an acute overdose usually causes symptoms, patients may present asymptomatic even after a lethal ingestion. Therefore, it is imperative that an acetaminophen level is checked on all overdose patients. There are four main stages of an acute APAP overdose. Typical symptoms usually involve nausea, vomiting in the first two stages. The lethal dose of APAP is 150mg/kg. In an acute overdose, APAP is metabolized to NAPQI which combines with glutathione and is excreted. When the majority of the glutathione is used, NAPQI causes hepatic toxicity. The toxic level of acetaminophen can be measured on the Rumak nomogram and the toxic plasma level at four hours is 150. In addition to decontamination with repeated doses of activated charcoal, the antidote N-acetylcysteine (Mucomyst) should be administered if indicated by the nomogram.

Aspirin

Unlike the Rumak nomogram of acetaminophen, the Done nomogram associated with aspirin ingestions is typically not used to determine toxicity and treatment. Patients with an acute overdose of aspirin are usually quite ill appearing, breathing fast, vomiting, confused, and sometimes febrile. The toxic effects are complex and involve an uncoupling of oxidative phosphorylation. This causes a profound anoin gap metabolic acidosis. The general approach to aspirin overdose is the management of the airway, gastric decontamination, the administration of sodium bicarbonate, and hemodialysis.

Tricyclic Antidepressants (TCA)

Tricyclic antidepressants have historically been some of the most dangerous agents ingested in an overdose situation. In addition to their anticholinergic properties, TCAs cause a direct alpha-adrenergic blockade, inhibition of norepinephrine and serotonin reuptake, and blockade of fast sodium channels in myocardial cells. This can lead to tachycardia, prolongation of the QRS complex, dysrhythmias, and cardiovascular collapse. They also cause protracted seizures. Treatment of TCA overdose includes close monitoring for a period of at least six to eight hours in the asymptomatic patient. In the setting of QRS widening, Sodium bicarbonate should be administered. Seizures are treated with benzodiazepines. Newer recommendations for lipid therapy exist in the treatment of severe toxicity.

Alcohols

While any alcohol consumed in great quantities can be dangerous, there are three major alcohols that are considered “toxic”. These “toxic” alcohols include isopropanol, methanol, and ethylene glycol. Isopropyl alcohol is found in many solvents, mouthwashes, and rubbing alcohols. Methanol is found in windshield wiper fluid. Ethylene Glycol is typically found in antifreeze. Patients who have ingested any of these agents may appear to be intoxicated or even comatose. It is important to obtain a metabolic panel on these patients. Isopropanol will not cause a metabolic acidosis, while methanol and ethylene glycol both cause a profound metabolic anion gap acidosis. Additional diagnostic measures include the application of a wood’s lamp to the urine of a patient with an ethylene glycol ingestions. Since the source is antifreeze, sometimes the urine in the setting will fluoresce. The urine can also be examined for the presence of calcium oxalate crystals.

Isopropanol is usually not life threatening and can be managed by supportive care. In rare instances hemodialysis may be required. Methanol and ethylene glycol, on the other hand, are more lethal and should be aggressively treated as soon as suspected. Methanol is metabolized to formaldehyde, and ethylene glycol is broken down into oxalate. All alcohols are metabolized by alcohol dehydrogenase (ADH). Therefore, the initial treatment for methanol and ethylene glycol involves the blockade of ADH. This can be accomplished by either simple ethanol or fomepizole. In addition, removal of the toxin may be necessary by hemodialysis. Sodium bicarbonate and glucose may also be necessary.

His EKG shows Sinus Tachycardia with normal intervals.

His labs return with an ABG as follows:

pH = 7.1, pCO2 = 25, pAO2 = 400.

His electrolyte panel and tox screen show

- *Na = 138, K = 5.8, Cl = 100, HCO3 = 9*
- *Acetominophen = 0.0, Salicylates = 0.0*
- *Ethanol = 86, TCA's = negative*

What did he take and how would you treat it?

Pearls and Pitfalls

- Poisoned patients can present in stable condition then deteriorate quickly
- Always obtain an acetaminophen level (can miss lethal overdose if not checked)
- In opiod OD, the Naloxone will wear off before the opiate so can?t let patient go
- Ask friends and family what patient may have taken (obtain pill bottles if possible)
- Don't let patient go unless certain that they are not a danger to themselves.

References

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