POISONING

Poisoning, Case #2

Written by David Eldridge, M.D.

A two year-old child is found in the bathroom with an open bottle of liquid drain cleaner. She has a small area of bleeding on her lips. What is the most serious toxicity of this ingestion/exposure?

Definitions for Specific Terms:

Liquid drain cleaner- What is "liquid drain cleaner? It is a strongly alkaline solution that typically contains sodium hydroxide. Exposure to this, and other caustic solutions, can lead to burns and necrosis of tissue.

Caustic- A broad, descriptive category that includes a variety of substances that can cause inflammatory or ulcerative tissue damage – including acids, alkali, and other corrosive agents.

Review of Important Concepts:

Historical Points

- What is the exact identity of chemical involved (composition of active ingredients)?
- Amount taken?
- How long ago did the ingestion occur (timeline)?
- Symptoms that may be concerning?
  - Refusal to drink
  - Drooling
  - Abdominal pain
  - Vomiting
  - Stridor or respiratory distress

Physical Exam Findings

1. Assess airway, breathing, and circulation (ABC's) with particular attention to airway as stridor may indicate laryngeal edema secondary to caustic injury and pending airway compromise.
2. Check for dermal or ocular burns.
3. Check for erythema or ulceration of the lips, mouth, and oropharynx
4. Palpate for abdominal tenderness

Clinical Reasoning

1. What is the role of gastrointestinal decontamination in this patient?
   Methods used to either adsorb or remove toxins from the stomach are generally contraindicated in caustic ingestions. The risk of emesis and further damage to the esophagus and airway is a concern. Gastric lavage specifically carries with it the risk of perforation with these ingestions. Activated charcoal does not bind these chemicals well and can obscure endoscopic evaluation when performed to assess the extent of caustic damage.

2. Should you attempt to neutralize ingested acids/base ingested with the opposite (e.g. administering a weak base to neutralize a strongly acidic ingestion)?
   Though this technique has been advocated by some in the past, most agree that this is not helpful as caustic tissue injury occurs immediately after contact. Also, such a mixture may produce significant heat and produce further damage.

3. Would giving the child water to drink in an attempt to dilute the liquid drain cleaner be helpful?
   Diluting a caustic chemical with water is also advocated by some, but it is controversial. Immediate dilution will theoretically reduce the contact that gastrointestinal tissue will have with a concentrated caustic substance. However, given that caustic injury occurs so quickly after contact, the clinical benefit is unclear. Furthermore, drinking water at this point may induce vomiting and subsequent reinjury with repeat contact with the caustic substance.

4. What signs and symptoms might indicate significant gastrointestinal injury?
   a. Children that present with refusal to eat or drink, pain with swallowing, drooling, abdominal pain, and vomiting may all indicate significant caustic injury.
   b. Visible mouth and oropharyngeal burns on physical exam suggest that other esophageal and gastric injuries have occurred. However, significant gastrointestinal injury has been reported in the absence of visible mouth or oropharyngeal injury.

5. What symptoms might indicate airway injury?
   Stridor and respiratory distress in this patient could indicate pending airway loss subsequent to laryngeal edema. Endotracheal intubation may be indicated.

6. What complications may occur after this type of ingestion?
   a. Severe esophageal and gastric burns are a concern after these ingestions.
   b. Subsequent perforation may also occur.
   c. Depending on the initial extent of these injuries, patients may also suffer from strictures after the initial injuries resolve.

7. Is there a role for steroids to prevent the complications from this ingestion?
   The use of steroids in the management of caustic ingestions remains controversial. Steroids have been examined as a therapy to decrease inflammation in an attempt to prevent subsequent stricture formation. Studies have shown mixed success with this therapy. If steroids are utilized in this setting, subsequent infection is a concern and concurrent use of antibiotics is generally recommended.

8. What further diagnostic evaluation should be considered in these types of ingestions?
   When strongly acidic or alkaline chemicals are ingested, or a patient's symptoms suggest significant gastrointestinal injury, endoscopic evaluation is needed to assess the esophagus and stomach. This assessment can be helpful in planning future management and anticipating the risk of stricture development in the future.

Suggestions for Learning Activities:

- Provide the students with the case scenario and ask them the questions under the clinical reasoning section.
- This case provides an opportunity to discuss the assistance that the Poison Control Center can provide in the management of these patients.
- This case provides an opportunity to discuss the importance of prevention. Students can be asked to identify other common caustic chemicals that are typically found in the home, which age groups that are at risk for these accidental exposures, and common failures of childproofing (e.g. storing chemicals in inappropriate containers). Household bleach (sodium hypochlorite) is one such chemical that, in contrast to liquid drain cleaner, rarely leads to serious injury. Subsequently, students could be asked to discuss the anticipatory guidance that could be provided to parents to prevent these exposures.

Other Resources:

- Pediatric Toxicology: Diagnosis and Management of the Poisoned Child, Erickson, TB, et al. (Eds.), Chapter 48. Acids and Alkali.

Poisoning, Case #3

Written by David Eldridge, M.D.

A two-year-old boy is brought to the Emergency Department in a coma after his mother found him limp and unresponsive in his room. What questions would you want to ask the mother to help learn why this patient might be unresponsive?

Definitions for Specific Terms:

Coma - What is a coma? A coma refers to a state of severely depressed mental status. Clinically the patient is unarousable and demonstrates an inability to respond (e.g. eye opening, speak, purposeful movement) to a variety of stimuli (e.g. verbal commands, questions, and painful stimuli).

Review of Important Concepts:

Historical Points

- Was her son behaving normally before she found him unconscious?
- How long was her son unobserved and unconscious (i.e. the timeline)?
- Was the child breathing when his mother found him? Cyanosis?
- Had the child vomited?
- What medications are available in the household (complete inventory of every family member's medications)?
- Did the child have access to other substances in the household (e.g. ethanol)?
- Are any other members of the household affected (e.g. carbon monoxide).

Physical Exam Findings

1. Assess airway, breathing, and circulation (ABC's).
   Auscultate the lungs - paying particular attention for crackles or decreased air entry.

2. Examine skin for breakdown and pressure necrosis that may have formed during prolonged immobility.

3. Check pupil size and reactivity to light.

4. Careful neurologic exam to assess for any neurologic deficits and severity of patient's coma (e.g. Glasgow Coma Scale).

Clinical Reasoning

1. How can pupillary size and reactivity assist in making the diagnosis of a toxin-induced coma?
   This portion of the physical exam can help narrow the spectrum of the differential diagnosis for this patient. Along with sedation, certain toxins also commonly induce a distinct change in pupillary size. Such associations include (but are not limited too):
   a. Miosis (constricted)
      - Opioids/opiates

- Clonidine
- Organophosphate/carbamate poisoning
- Phenothiazines and atypical antipsychotics

b. Mydriasis (dilated)
- Antihistamines
- Tricyclic antidepressants
- Anticholinergics (e.g. scopolamine and atropine)

2. Poor pupillary response to light may be concerning for increased intracranial pressure.

3. Other physical exam findings may help identify a responsible toxin and help direct therapy. For example organophosphate poisoning may produce classic DUMBBELS findings [diarrhea, urination, miosis, bradycardia (or tachycardia), bronchorrhea/bronchoconstriction, emesis, lacrimation, and salivation.] Identifying a toxic syndrome such as this can be more immediately helpful than laboratory testing in terms of directing treatment.

4. What are the main causes of morbidity and mortality in this case?
   a. When a patient is comatose, apnea and subsequent hypoxic injury is a major cause of morbidity and mortality.
   b. Pulmonary aspiration is also a concern.
   c. For these reasons, providing supplemental oxygen along with assisted ventilation and airway protection (intubation) are therapeutic priorities for these patients.
   d. If a patient has been immobile for a significant period of time, areas of pressure necrosis may also have begun to form, and rhabdomyolysis may become a subsequent concern.

5. Will drug testing be helpful in making the diagnosis in this case?
   a. Laboratory testing for poisons and substances should be focused. A urine drug screen may be helpful in this case, but these tests typically only detect some drugs of abuse. Even then, not all drugs in a category may be detected (e.g. an opioid screen may not detect methadone).
   b. If substances are accessible according to a patient's history, specific drug levels may be helpful (e.g. phenobarbital).
   c. Also key physical exam findings (e.g. miosis) may help narrow the differential diagnosis and guide laboratory testing, making it higher yield.

Diagnosis:

1. What toxins can cause this clinical picture?
   The list of poisons and substances that can cause coma is extensive. Some examples include (but are not limited too):
   a. Anticholinergics
   b. Anithistamines
   c. Atypical antipsychotics
   d. Barbiturates
   e. Benzodiazepines
   f. Carbon monoxide
   g. Clonidine
   h. Ethanol
   i. Opioids/Opiates

j. Organophosphates/carbamates
k. Phenothiazines
l. Tricyclic antidepressants

2. Besides a toxic exposure, what other causes of coma are on the differential diagnosis for this patient? The list may be broad, but certain emergent diagnoses should be considered. Examples include:
   a. Encephalitis/meningitis
   b. Head trauma
   c. Epilepsy (postictal state)
   d. Hypothermia/hyperthermia
   e. Diabetic ketoacidosis

Suggestions for Learning Activities:

- Have the students obtain a Glasgow Coma Scale and then assess the patient's airway, breathing, and circulation. They can then decide on appropriate interventions (e.g. the need for intubation).
- With each item on the list of possible toxins in this case, discuss other physical exam findings that can be expected with each toxin (review toxic syndromes).
- When appropriate, review specific antidotes or other treatments that would be helpful for each of these toxins (e.g. atropine and pralidoxime for organophosphate poisoning).

Other Resources:

- Rudolph's Fundamentals of Pediatrics, chapter entitled Injuries & Emergencies, section entitled "Coma." Similar chapters in standard pediatric textbooks will also cover this.

Poisoning, Case #4

Written by David Eldridge, M.D.

You receive a phone call from the mother of a 12 kg two year-old child who was found eating her mother's prenatal vitamins that contain iron. Each tablet contains 60 mg of elemental iron. She thinks he may have swallowed 16 tablets. What amount of elemental iron ingestion is potentially toxic for a child? What additional information do you need from the mother? What advice would you give the mother?

Definitions for Specific Terms:

Iron toxicity- This type of poisoning typically occurs from the ingestion of iron supplements (e.g. prenatal vitamins). The amount of elemental iron ingested determines the risk that a child will develop iron toxicity. The preparation of iron involved must be considered when calculating the amount of elemental iron ingested. The amount of elemental iron, by percent weight, for some common iron preparation includes: ferrous gluconate (12%), ferrous lactate (19%), ferrous sulfate (20%), ferrous chloride (28%), and ferrous fumurate (33%).

Toxic dose of elemental iron- Once the amount of elemental iron potentially ingested is known, the risk of toxicity can be predicted based on the weight of the child. Children may become symptomatic at 20-40 mg/kg of elemental iron. Ingested amounts of elemental iron exceeding 40 mg/kg place a child at risk for serious toxicity. Those exceeding 60 mg/kg must be considered at risk for life-threatening toxicity. Because iron toxicity is such a potentially dangerous ingestion, it is always best to be cautious and have the child clinically evaluated immediately if the amount of iron ingested is unclear.

Review of Important Concepts:

Historical points

- What kind of iron supplement was ingested?
- Amount taken (how many tablets)?
- How long ago did the ingestion occur (timeline)?
- How much does the child weigh?
- Is the child displaying concerning gastrointestinal symptoms that are the hallmark of early iron toxicity?
  - Change in mental status (e.g. lethargy or coma)
  - Vomiting
  - Diarrhea
  - Abdominal pain
  - Hematemesis
  - Hematochezia
  - Melena

Physical Exam Findings

1. Assess airway, breathing, and circulation (ABC's) with particular attention to circulation, as shock is the most common cause of mortality from iron poisoning and can be seen early in the course of this ingestion.

2. Careful assessment of peripheral perfusion and vital signs is essential.

3. Concerning findings include:
   a. Tachycardia
   b. Hypotension
   c. Pallor
   d. Delayed capillary refill
   e. Depressed mental status may be present with shock.
   f. Abdominal tenderness on palpation.

Clinical Reasoning

1. Does this child need to be referred to the emergency department?
   a. Iron poisoning is a potential life-threatening ingestion. The decision to have a child referred for clinical evaluation can be made based on the amount ingested and the presence of symptoms. If the amount of iron ingested can be reliably determined, the total dose ingested can be helpful. Generally, if a child has potentially ingested >40mg/kg, they are at risk for severe toxicity and require medical evaluation. However, even at lower doses, a child must receive similar, emergent care if they are symptomatic (typically gastrointestinal symptoms).
   b. If a total dose cannot be determined by this child's mother, the presence of symptoms alone justifies immediate medical evaluation.

2. What is the role of home gastrointestinal decontamination in this patient?
   a. The use of syrup of ipecac, as means to induce emesis and attempt to evacuate pills from the stomach, is no longer recommended for gastrointestinal decontamination.
   b. The use of activated charcoal (AC) at home has received some attention as a potential replacement of ipecac, but the evidence regarding its efficacy is unclear. However, ingested AC does not bind to iron and therefore has no role with this ingestion. If iron poisoning is a concern, referral to a medical facility is the main intervention.

3. Is there a role for gastrointestinal decontamination at a hospital?
   Many will recommend the use of whole bowel irrigation (WBI) with large amounts of polyethylene glycol electrolyte solution in an attempt to flush out iron supplements from the gut. Some recommend this intervention for toxic doses of iron or if large amounts of pills are seen on an abdominal radiograph. The use of WBI should be carefully scrutinized. If a patient has an active gastrointestinal bleed or obstruction or if they are in shock, WBI is contraindicated. Discussion regarding the use of WBI with a regional poison control center may be helpful.

4. What is the antidote for iron poisoning and how does it work?
   Intravenous deferoxamine chelates iron and is the antidote of choice for iron poisoning.

Diagnosis:

1. Will obtaining a serum iron level be helpful in the management of iron poisoning?
   a. The diagnosis of iron poisoning and the decision to refer for medical evaluation should be based on the estimated amount of iron ingested and the presence of symptoms. An iron level obtained during the period of peak absorption (typically 2-6 hours after ingestion) is helpful. Peak levels less than 300 µg/dL are not generally associated with toxicity while levels of 500 µg/dL and above are associated with serious toxicity. Iron concentrations between these ranges may be associated with toxicity.
   b. It is vital to interpret iron levels in the context of a patient's history, symptoms, and clinical status. Serial iron levels should be considered, especially if a timeline of the ingestion is unclear.

2. What is the role of abdominal radiography in the diagnosis of iron poisoning?
   a. Depending on the content of elemental iron and type of preparation, some iron supplements are radiopaque. Therefore, radiography may be helpful in confirming the presence of iron supplements, and even quantifying their number, in the gastrointestinal tract.
   b. If iron tablets are present on a radiograph, the use of WBI is more easily justified. However, the absence of visible tablets does not rule out iron poisoning as some supplements are not radiopaque or may have dissolved prior to obtaining radiography.

3. Are there any other diagnostic tests that may be helpful in making the diagnosis of iron toxicity? Leukocytosis, hyperglycemia, and a wide anion gap metabolic acidosis may all be seen with iron poisoning. However, these laboratory findings are not specific.

Suggestions for Learning Activities:

- Provide the students with the case scenario and ask them the questions under the clinical reasoning section.
- This case provides an opportunity to role play a phone triage situation. The instructor can discuss the challenges of gathering clinical data by phone and of make use of other sources of information (e.g. electronic medical record) in order to make decisions.
- Ask the students to calculate how many mg/kg that this child may have ingested based on the iron formulation ingested, the suspected number of pills involved, and the child's weight.

Other Resources:

- Pediatric Toxicology: Diagnosis and Management of the Poisoned Child, Erickson, TB, et al. (Eds.), Chapter 68. Iron.