

Iron Toxicity in Emergency Medicine

Author: Clifford S Spanierman, MD, Consulting Staff, Departments of Emergency Medicine and Pediatrics, Lutheran General Hospital of Oak Brook, Advocate Health System
[Contributor Information and Disclosures](#)

Updated: Mar 16, 2010

Introductio

Background

Iron overdose has been one of the leading causes of death caused by toxicological agents in children younger than 6 years. Iron is used as a pediatric or prenatal vitamin supplement and for treatment of anemia. Iron is particularly tempting to young children because it appears similar to candy. Patients with anemias that require frequent blood transfusions also are at risk for developing chronic iron toxicity.

Iron overload may develop chronically as well, especially in patients requiring multiple transfusions of red blood cells. This condition develops in patients with [sickle cell disease](#), [thalassemia](#), and [myelodysplastic syndromes](#).

Pathophysiology

Iron toxicity can be classified as corrosive or cellular.

- Corrosive toxicity: Iron is an extremely corrosive substance to the GI tract. It acts on the mucosal tissues and can manifest with nausea, vomiting, abdominal pain, hematemesis, and diarrhea; patients may become hypovolemic because of significant fluid and blood loss.
- Cellular toxicity: The absorption of excessive quantities of ingested iron results in systemic iron toxicity. Severe overdose causes impaired oxidative phosphorylation and mitochondrial dysfunction, which can result in cellular death. The liver is one of the organs most affected by iron toxicity, but other organs such as the heart, kidneys, lungs, and the hematologic systems also may be impaired.
- End result of corrosive and cellular toxicity is significant [metabolic acidosis](#) due to several factors.
 - Hypoperfusion due to significant volume loss, vasodilatation, and negative inotropic effect of iron will result in [lactic acidosis](#).
 - Inhibition of oxidative phosphorylation will promote anaerobic metabolism.

Individuals demonstrate signs of GI toxicity after ingestion of more than 20 mg/kg. Moderate intoxication occurs when ingestion of elemental iron exceeds 40 mg/kg. Ingestions exceeding 60 mg/kg can cause severe toxicity and may be lethal.

Suggested doses are based on calculation of the amount of elemental iron. Different iron preparations (salts) contain different amounts of elemental iron.

- Fumarate - 33%
- Sulfate - 20%
- Gluconate - 12%

Chronic iron overload may deposit iron into organs such as the liver and heart, which may cause death due to myocardial siderosis.

Frequency

United States

More than 20,000 children accidentally ingested iron in 1995.¹ Iron was the most common cause of childhood mortality due to nonintentional ingestion. The incidence of iron poisoning has decreased dramatically.

Mortality/Morbidity

Iron poisoning may result in mortality or short-term and long-term morbidity.

Sex

Pregnant patients are at increased risk due to availability of prenatal vitamins and iron supplements in addition to the emotional stress that pregnancy can precipitate.

Age

Iron overdose is one of the leading causes of fatality from toxicological agents in children younger than 6 years.

Clinical

History

- Alert patients who present without vomiting most likely did not ingest a toxic dose of iron.
- More than 4 episodes of vomiting suggest significant iron toxicity.
- Iron ingestions with GI symptoms such as vomiting and diarrhea (especially hemorrhagic)
- Hemorrhagic gastroenteritis, even in the absence of ingestion
- Hyperglycemia with metabolic acidosis during or following episodes of abdominal pain and gastroenteritis

Physical

Iron poisoning is often classified into 5 distinct stages. Understanding the course of poisoning is important, especially the second (recovery) stage, which may lure the physician into a false sense of security and result in premature and inappropriate discharge of a patient.

- Stage 1 (gastrointestinal)
 - This stage usually occurs within 6 hours after exposure.
 - Nausea and diarrhea, often accompanied by abdominal pain, characterize the gastrointestinal (GI) phase.
 - When the intoxication is severe, a hemorrhagic component is observed in conjunction with gastroenteritis.
 - The combination of fluid and blood loss, with additional third-spacing, may result in hypovolemia or shock.
 - Fatality occurs in a significant percentage of patients during this first phase.
- Stage 2 (latent)
 - This stage is characterized by resolution of GI symptoms.
 - The patient appears to improve and recover.
 - This deceptive phase usually occurs 6-12 hours after ingestion and may last as long as 24 hours.
 - Metabolic abnormalities during this phase may include hypotension, metabolic acidosis, and coagulopathy.
 - Some patients skip this phase and progress directly to stage 3. Usually, the clinician does not recognize subtle signs of toxicity.
- Stage 3 (metabolic/cardiovascular)
 - Stage 3 is characterized by metabolic acidosis and cardiovascular symptoms.
 - It is hypothesized that high iron concentrations produce venous pooling and third-spacing of fluids.
 - This phase is also characteristic of CNS symptoms, usually stupor and coma.
 - Most patients die during this phase.
 - It can start very early (6-8 h), depending on severity of exposure, and it can last up to 2 days.
 - The acidosis may indicate failure of other organs, such as the heart and kidneys.
- Stage 4 (hepatic)
 - Elevated liver enzymes and bilirubin levels are commonly observed with coagulopathy, indicative of hepatic dysfunction.

- Hypoglycemia may accompany liver dysfunction.
- Stage 5 (delayed)
 - This stage is characterized by scarring of the healing GI tract. The stomach and/or intestines may be affected, resulting in gastric outlet or intestinal obstruction.
 - This phase usually is experienced weeks after a severe poisoning.

By <http://emedicine.medscape.com/article/815213-overview>