



Clinical Pharmacology & Toxicology Pearl of the Week

~ Hydrogen Peroxide (H₂O₂) ~

Case:

- A 40-year-old man unintentionally ingested two sips of 33% hydrogen peroxide while at work, mistaking it for water
- Soon after ingestion, the patient vomited and went to the local emergency department
- Several minutes after arriving in the emergency department, the patient had hematemesis, followed by a headache, problems with his vision, and difficulty following commands. This was followed by left sided weakness and confusion
- CXR and CT head were normal
- MRI of the brain showed multiple areas of cerebral ischemia
- How should this patient be treated?

Background:

- Hydrogen peroxide has a long history of use as an antiseptic and disinfectant
- It is available in two strengths: dilute (concentration of 3%, sold for home use), and concentrated (concentration of greater than 10%, sold for commercial purposes)
- Commercial uses of the higher concentrated solutions include cleansing textiles and wool, and producing foam rubber and rocket fuel
- 35% hydrogen peroxide ("food grade hydrogen peroxide") is also available to the public

Toxicity:

- Toxicity from 3% H₂O₂ is rare, whereas toxicity from ingestion of higher concentrations is common and potentially life threatening
- Toxicity can occur after ingestion, inhalation, injection, wound irrigation, rectal administration, dermal exposure, and ophthalmic exposure
- Toxicity is from local tissue irritation and gas formation
- Hydrogen peroxide interacts with tissue catalase to form molecular oxygen
- Gas emboli may form because of dissection of gas under pressure into the tissues or liberation into the blood

Clinical features:

- Ingestions of 3% hydrogen peroxide are typically benign with mucosal toxicity being the most reported sign
- Ingestions of concentrated hydrogen peroxide has resulted in the following complications:
 - Resp: stridor, drooling, dyspnea, apnea
 - GI: bloating abdominal pain, vomiting, hematemesis
 - CNS: rapid deterioration in mental status (e.g., syncope, loss of consciousness), seizures, acute paraplegia

Imaging:

- CXR may show air in the cardiac chambers, mediastinum, or pleural space
- AXR may show gas in GI tract, portal venous gas, bowel distention
- CT and MRI may show features of cerebral and spinal ischemia

Figure 1: CT abdomen showing portal venous gas after hydrogen peroxide ingestion (from French et al.)

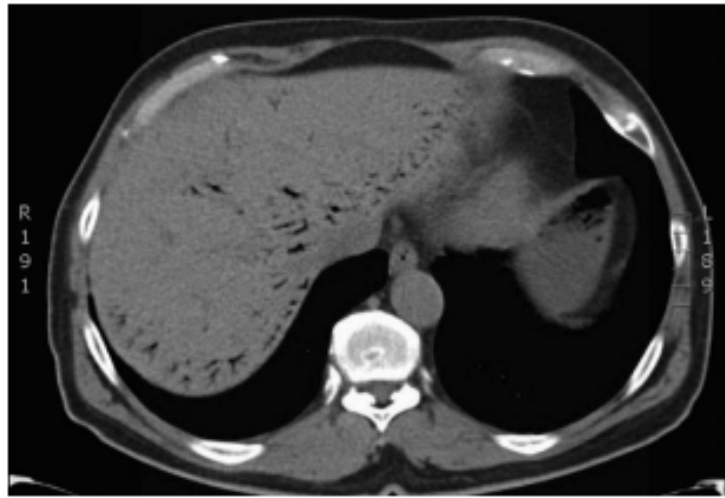
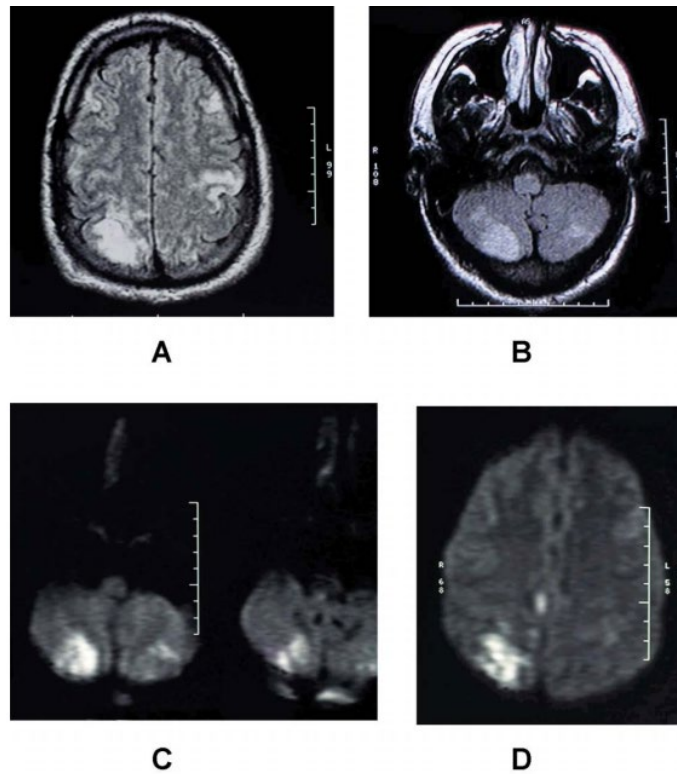


Figure 2: MRI Brain showing cerebral ischemia after hydrogen peroxide ingestion (from Rider et al.)



Management:

- ABC's
- GI endoscopy may be necessary in patients with ingestions of greater than 3% concentration H₂O₂ because of corrosive injury
- Hyperbaric oxygen therapy works by decreasing bubble size and by increasing the solubility of O₂ in plasma, forcing gas emboli back into solution, where the excess gas can be counter-diffused and ventilated off by the lungs
- Indications for HBO therapy may include any of the following and require discussion with a hyperbaricist:
 - clinical features of cerebral arterial gas embolism
 - clinically significant discomfort due to gastric or portal venous gas (some references suggest the presence of portal venous gas as a separate indication, regardless of symptoms)
 - a critically ill, intubated patient where a full neurologic examination is difficult
 - gas in the right side of the heart (which increases the risk of potential arterial gas embolism)

The Calgary Clinical Pharmacology physician consultation service is available Mon-Fri, 8am-5pm. The on-call physician is listed in ROCA. Clinical Pharmacology consultations are also available through the Netcare e-referral process and through Calgary Zone Specialist Link. Click [HERE](#) for more details.

The Poison and Drug Information Service (PADIS) is available 24/7 for questions related to poisonings. Please call 1-800-332-1414 (AB and NWT) or 1-866-454-1212 (SK).

References:

1. Byrne et al. Hyperbaric oxygen therapy for systemic gas embolism after hydrogen peroxide ingestion. *J Emerg Med* 2014. 46(2): 171-5.
2. Rider et al. Cerebral air gas embolism from concentrated hydrogen peroxide ingestion, *Clinical Toxicology*, 46:9, 815-818, DOI: 10.1080/15563650701725136.
3. Hendriksen et al. Hyperbaric oxygen therapy for the prevention of arterial gas embolism in food grade hydrogen peroxide ingestion. *American Journal of Emergency Medicine* 35 (2017) 809.e5-809.
4. French et al. Hydrogen peroxide ingestion associated with portal venous gas and treatment with hyperbaric oxygen: a case series and review of the literature, *Clinical Toxicology*, 48:6, 533-538, DOI: 10.3109/15563650.2010.492526.