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Intentional Ingestion of Hydrogen Peroxide

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Abstract

Introduction: Hydrogen peroxide poisoning can cause death. The chemical reactions in the body will produce complications, such as stroke, perforation of the gut, and embolism. These complications are most likely seen with high concentrations.
Case Presentation: The patient was a 55-year-old female, who tried to commit suicide by ingestion of approximately 150 cc of hydrogen peroxide. She was brought to the emergency room for medical treatment. During the physical examination, the patient had air in the neck and mediastinum, which is a strong indication of acute mediastinitis. The patient was treated with esophagectomy and feeding jejunostomy. The pathology reported first degree burns of the esophagus without perforation. The patient underwent reconstructive surgery and treatment for eight weeks, yet she died during surgery as a result of low ejection fraction (EF).
Conclusions: In this case, the patient intentionally ingested a low concentration (15%) of hydrogen peroxide and as a result experienced first degree burns in the esophagus. The patient did not require surgery for treatment. The presence of white mucus and air around the esophagus and stomach was thought to be indicative of acute mediastinitis and mistakenly exposed the patient to major surgery.

Keywords: Hydrogen Peroxide, Chemical Ingestion, Poisoning

1. Introduction

Hydrogen peroxide acts as an oxidant and as an antiseptic. This chemical also has anti-bacterial, anti-fungal, and anti-viral properties. This combination of properties uniquely qualifies hydrogen peroxide for sterilization of hollow and porous equipment as well as deep cleaning of wounds. Hydrogen peroxide can be hazardous to human health by inhalation, ingestion, and by direct contact with the skin. Ingestion of hydrogen peroxide is a common method of toxicity, which causes direct damage of tissues by producing of oxygen and lipid peroxidation.

Low-level concentrations (3% to 9%) are used for cleaning wounds, contact lenses, and endoscopy equipment (1). High-level concentrations (20% to 30%) are used to bleach hair and teeth (2). Solutions with less than or equal to 3% concentration are usually not harmful, yet ingestion of hydrogen peroxide with a concentration of more than 10% has adverse effects, including death.

This chemical can cause severe toxicity if ingested, yet it can be used for cleaning wounds as well as rectal enemas. Adverse effects, such as air embolism and ulcers in the rectum have limited its clinical use (1). However, diluted forms of hydrogen peroxide have been used in the treatment of AIDS (2). Intravenous and oral solutions have been used for oxygenation of the lungs in patients with COPD and for improvement of glucose control in patients with diabetes (3). After hydrogen peroxide has been ingested, it enters the blood stream, and excess oxygen gas from decomposition enters the portal system. When the amount of gas in the blood exceeds its solubility, gas embolism occurs (4, 5). Gas embolism can cause neurologic complications, such as cerebral infarction and mesenteric ischemia, with mortality rates as high as 75% to 90% (2, 6).

2. Case Presentation

The patient was a 55-year-old female with a history of heart failure and coronary artery bypass graft (CABG). She intentionally ingested a glass of 150 mL of 15% hydrogen peroxide six hours before arriving to the emergency department (ED). The patient gradually had hoarseness, dysphagia, and dyspnea. She complained of epigastric pain and throat irritation and vomited three times. Each time, there was about 100 cc of blood and dark color vomitus. On arrival, the patient was conscious and her vital signs were as follows:

Blood pressure (BP): 130/80 mmHg; rulse rate (PR): 92 beats per minute; respiratory rate (RR): 28 breaths per minute; axillary temperature (AT): 37.4°C.

The patient wasn't able to speak clearly and had interrupted speech. On examination, no sign of burns was seen around the lips or mouth. The patient had an erythematous throat yet no difficulty swallowing. The patient had neck and upper chest subcutaneous emphysema with extension to the deltoid region, yet no sign of tracheal deviation. Drooling was noticeable. Lung expansion was symmetrical and scar of CABG was present in her sternum. Lungs were resonant to percussion, bilaterally, and brief crackles were present bilaterally on auscultation. On auscultation of the heart, S1 and S2 heart sounds were not clearly discernible. On abdominal examination, the abdomen was non-tender and non-distended. Mild tenderness in the epigastric region without guarding was detected. Physical examination of the upper and lower extremities was unremarkable.

2.1. Laboratory Findings

Arterial blood gas pH: 7.38; PCO_2: 32; HCO_3: 18.

The chest X-ray showed pneumomediastinum and lateral neck X-ray showed subcutaneous emphysema in the neck (Figure 1). The CT scan of the chest was done and showed large amounts of emphysema in the neck, mediastinum, pericardial, and para-tracheal regions (Figure 2).

Eventually, the patient developed respiratory distress, subcutaneous emphysema, and pneumomediastinum with impression of esophageal perforation, which made her a candidate for total esophagectomy. After prep and drape in the supine position under general anesthesia, the abdomen was opened by midline incision. Air was detected in the sub-serosa and around the stomach that prompted a gastrotomy, revealing edematous, pale, and fragile mucosa of the stomach. A biopsy was taken from the posterior gastric wall, and with classic incision in anterior of left sternocleidomastoid muscle (SCM), the esophagus was explored. It was edematous with large amounts of air around it. Trans-hiatal esophagectomy was performed with impression of perforation of esophagus. For the gastric wall, biopsy and gastrotomy repair was done. The surgery was ended with insertion of esophagostomy and feeding jejunostomy. The patient's condition improved, was stable, and she was discharged seven days after the surgery. In histopathology study reported mucosal edema associated with inflammation and necrosis with limited area, without perforation of the esophagus. Eight weeks after discharge, the patient was readmitted for esophageal reconstruction. During gastric release and substernal tunneling, the patient had cardiopulmonary arrest and died, due to EF of 20%.

2.2. Treatment and Follow-Up

Ingestion of 3% hydrogen peroxide is less likely to cause any side effects or complications, yet the likelihood of morbidity and mortality remains high with concentration of 35% or higher. Treatment of patients depends on volume and concentration of the ingested hydrogen peroxide. The recommended treatment includes securing the airways when needed, monitoring closely the vital signs of patients, and treatment of the resulting complications. To detect air embolism and perforation of hallow viscous organ, X-ray and CT scan are useful modalities (7). For all patients, except for patients with suspected perforation, visceral and unstable vital signs endoscopy should be performed. Esophageal narrowing usually occurs within six to 12 weeks after the ingestion. Endoscopy follow-up must be done to monitor the extent of esophageal damage (8). The study showed that the intravenous cimetidine was more effective compared to PPI in ingestion of hydrogen peroxide (9). Cerebral air embolism may be managed with hyperbaric oxygen therapy (2, 10, 11).

3. Discussion

Hydrogen peroxide can generate oxidative metabolism in cells. The reactions by the enzymatic catalyzation in the liver and red blood cells, break down the hydrogen peroxide into water and oxygen. The toxic effects on cells are the result of gas production and direct tissue damage (12). Ingestion of low concentrations of hydrogen peroxide may cause nausea, vomiting, abdominal distension, and hematemesis. However, at higher concentrations, death may occur. One milliliter of hydrogen peroxide with a concentration of 30% at normal temperature and pressure produces about 100 cc of oxygen gas. The accumulation of large amounts of oxygen in hollow viscous organs can cause mechanical stress and perforation (1). Hydrogen peroxide is an unstable compound and in the presence of catalase enzyme in the cell membranes of the liver, kidneys, and red blood cells, almost immediately, it is converted to water and oxygen. Ingestion of hydrogen peroxide at a concentration of 3% usually causes only mild gastritis but ingestion of high concentrations, such as 35%, can cause erosion, ulceration, and perforation of the digestive system (1). Enteritis caused by the ingestion of hydrogen peroxide can present as bubbles in the mucosal surface, and appear as gray areas on mucosal surface, known as Snow White. This is a result of absorption of hydrogen peroxide in epithelial cells and capillary surface, which turns white due to the production of small bubbles of oxygen molecules (12).

Hydrogen peroxide also has significant harmful effects on the respiratory system. This chemical can cause

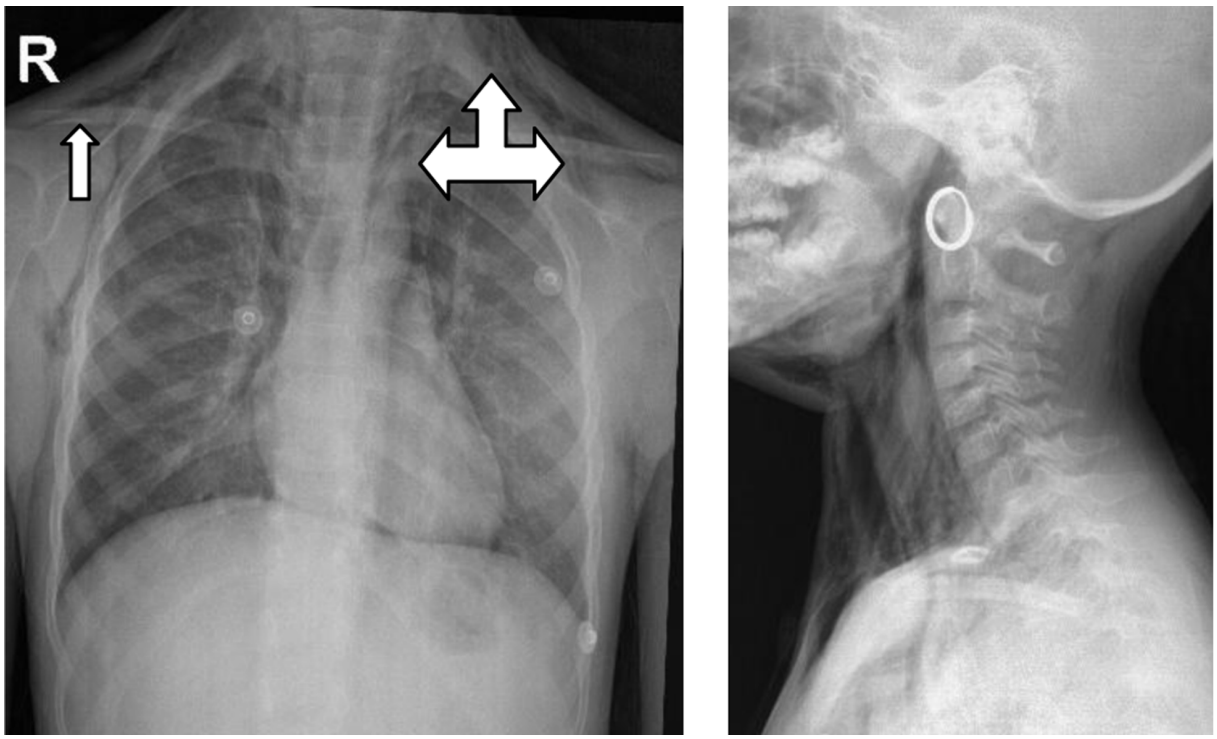

Figure 1. Subcutaneous emphysema in neck and pneumomediastinum (arrows)

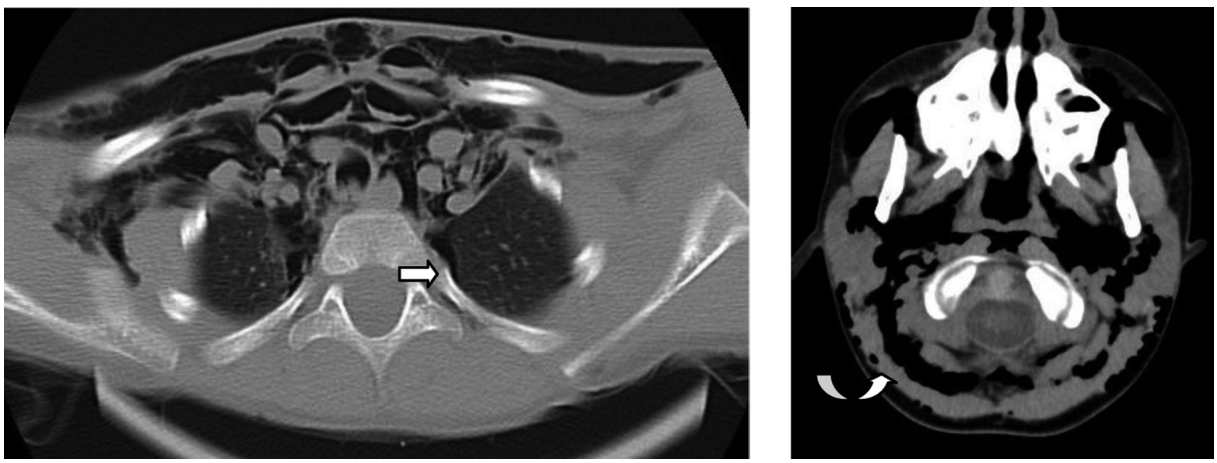

Figure 2. Lung CT scan (arrows)

subglottic stenosis and laryngospasm (1). When a large amount of oxygen enters the bloodstream quickly, it can cause air embolism in various organs, including the portal system, stomach, and brain (1). In this patient, despite the ingestion of hydrogen peroxide at a concentration of 15%, grade 2 caustic injury was proposed. In the pathologic exam, it was concluded that the patient did not need this major surgery. A big mistake occurred due to a clinical index of suspicious for grade 3 esophageal injury, perforation and mediastinitis, white appearing mucosa and air around the esophagus in clinical exam, and radiological findings caused the diagnostic error by surgical team that exposed the patient to unnecessary major surgery.

Overall, the clinical evidence, such as subcutaneous

emphysema, impression of esophageal perforation, CT scan of the chest and past medical history of the patient, made the medical team to decide on a surgical approach in this case. A different approach may have had a different outcome, which at this point is just a speculation, and would require further studies with a larger number of patients.

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