Outcomes After High-Concentration Peroxide Ingestions

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Study objective: In cases of high-concentration peroxide ingestion reported to US poison centers, we describe medical outcomes, examine the role of hyperbaric oxygen, and review the use of endoscopy.

Methods: The study was a retrospective analysis of a structured database, the National Poison Data System. The chart for each poison center case of a high-concentration (>10%) peroxide ingestion was obtained and abstracted in a standardized fashion; 1,054 cases were initially considered and 294 cases met inclusion criteria. The primary outcome of possible embolic event was defined as seizure, altered mental status, respiratory distress, hypoxia, hemodynamic instability, ECG changes, radiographic evidence of cerebrovascular accident, focal neurologic deficit on examination, pulmonary embolism, cardiac emboli, elevated troponin level, physician bedside diagnosis, or rapid improvement after hyperbaric oxygen therapy. Both descriptive statistics and logistic regression models were used to analyze the data.

Results: In the 10-year study period, 41 of 294 patients (13.9%; 95% confidence interval 10.2% to 18.4%) with symptoms after high-concentration peroxide ingestion demonstrated evidence of embolic events, and 20 of 294 (6.8%; 95% confidence interval 4.2% to 10.3%) either died or exhibited continued disability when the poison center chart was closed. Improved outcomes were demonstrated after early hyperbaric oxygen therapy. Endoscopy revealed grade 3 or 4 lesions in only 5 cases.

Conclusion: Symptomatic high-concentration peroxide exposures had a high incidence of associated embolic events in this cohort. Patients with evidence of embolic events had a high rate of death. Early hyperbaric oxygen therapy may be useful, but routine endoscopy is unlikely to be of benefit. [Ann Emerg Med. 2017;69:726-736.]

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INTRODUCTION

Background

Hydrogen peroxide is a colorless, odorless liquid typically encountered at household concentrations of 3% to 5%. It is a weak acid (pK_A 11.75) and a strong oxidizer. At this strength, it is commonly used for wound irrigation, hair treatment, and other cosmetic purposes. Household-concentration peroxide is widely acknowledged as safe, with the rare case of harm after massive ingestion or irrigation under pressure.

In contrast, a much greater danger is posed by exposures to high-concentration peroxide (>10%). Peroxide at this concentration is most often encountered in commercial settings, stored in bulk for dilution to household strength often with a label of "food grade hydrogen peroxide," or as part of complementary or alternative medicine therapy. In the latter indication, small amounts are diluted to "hyperoxygenate" the body.

Few in the medical community are aware of the dangers associated with exposure to this product. On contact with tissue, 1 mL of 35% hydrogen peroxide rapidly releases approximately 100 mL of oxygen.[1] The strong oxidizing properties of hydrogen peroxide and sudden volume of oxygen released in high-concentration ingestions have resulted in multiple case reports of harm in users. The proposed mechanisms of toxicity include gas embolism, caustic injury, and direct cytotoxic effects. It is presumed that local injury to the gut vascular wall and massive concentration gradients allow entry into the circulatory system. In the majority of cases, radiography demonstrates large amounts of gas in the portal system, associated with abdominal pain and nausea. However, in some cases, suspected arterial embolic effects have been observed. These include focal neurologic deficits suggestive of cerebrovascular accident; tachycardia, hypotension, and

Editor's Capsule Summary

What is already known on this topic

High-concentration hydrogen peroxide exposures are toxic.

What question this study addressed

What are the effects of high-concentration hydrogen peroxide exposures in humans?

What this study adds to our knowledge

In a retrospective national poison database analysis reviewing all symptomatic high-concentration peroxide exposures during a 10-year period, a high incidence of embolic events and permanent disability or death occurred among 294 symptomatic patients. Early hyperbaric oxygen therapy may decrease the risk of subsequent embolic events. Clinically important caustic injury was rare.

How this is relevant to clinical practice

After this exposure, patients should be monitored for embolic events. Routine endoscopy for caustic lesions is not warranted.

dyspnea consistent with pulmonary embolism; and hypotension and elevated troponin level consistent with cardiac emboli.[1-8] Unfortunately, the current body of literature is limited to case series and case reports. Therefore, the spectrum of disease, commonness of severe outcomes, and potential benefits of interventions have not been studied in a systematic fashion.

In some cases, hyperbaric oxygen therapy has been used to reduce bubble size or enhance reabsorption of gas bubbles in the bloodstream, with various degrees of success.[9] Hyperbaric oxygen may also be used in an attempt to prevent delayed or persistent sequelae from ischemic perfusion injury. The largest case series to date documented 11 patients at a single site.[6] At this center, an aggressive protocol of early computed tomography (CT) and hyperbaric oxygen therapy was used in cases of portal venous gas even without other embolic signs and symptoms. It is unclear whether this protocol improved outcomes compared with those at other centers because no single center encounters sufficient cases for comparative analysis.

Additional injuries that may require intervention include caustic effects. Given the reliable presence of abdominal discomfort and frequent presence of scant hematemesis, endoscopy is often performed. However, there has been no systemic analysis of the necessity of endoscopy in cases of peroxide exposure. Furthermore, the relationship between embolic events and caustic injury is also not certain.

Consequently, there is limited evidence to inform diagnostic or therapeutic decisionmaking in regard to high-concentration peroxide ingestions. Theoretical and mechanistic rationales have driven previous recommendations, but the optimal management strategy has not been examined, to our knowledge.

Importance

High-concentration peroxide ingestions have been associated with embolic events in previous case reports and case series. However, the epidemiology, diagnostic and treatment variation, and outcomes related to such exposures have not been systematically studied because of the rare nature of the exposure—294 cases reported during 10 years to all US poison centers in this study—preventing a single center from performing an analysis of high-concentration peroxide ingestions. Furthermore, many cases result in serious disability or death.

Goals of This Investigation

In cases of high-concentration peroxide ingestions reported to US poison centers, our goal is to describe medical outcomes, examine the role of hyperbaric oxygen, and review the use of endoscopy after exposure.

MATERIALS AND METHODS

Study Design

The study is a retrospective analysis of a structured database, the National Poison Data System (NPDS) of the American Association of Poison Control Centers (AAPCC). The NPDS database contains all cases collected by US poison centers, with all centers using a standard format. Major fields are required before a case can be closed, ensuring complete reporting for significant events. However, data available through NPDS are limited in detail aside from required fields. Thus, the original chart for each poison center case was also requested from the original center and abstracted in a standardized fashion to obtain study-specific details missing from NPDS. Poison center documentation standards beyond NPDS minimum requirements vary greatly both between centers and from case to case. Consequently, there was incomplete ascertainment of many of the variables that were not NPDS required fields.