



doi:10.1016/j.jemermed.2009.07.043

Clinical Communications: Adults

TREATMENT OF PORTAL VENOUS GAS EMBOLISM WITH HYPERBARIC OXYGEN AFTER ACCIDENTAL INGESTION OF HYDROGEN PEROXIDE: A CASE REPORT AND REVIEW OF THE LITERATURE

Sotirios Papafragkou, MD, Anna Gasparyan, MD, Richard Batista, MD, and Paul Scott, MD

Department of Surgery, Nassau University Medical Center, East Meadow, New York

Reprint Address: Sotirios Papafragkou, MD, P.O. Box 72, Fort Kent, ME 04743

Abstract—Background: It is well known that hydrogen peroxide ingestion can cause gas embolism. **Objective:** To report a case illustrating that the definitive, most effective treatment for gas embolism is hyperbaric oxygen therapy. **Case Report:** We present a case of a woman who presented to the Emergency Department with acute abdominal pain after an accidental ingestion of concentrated hydrogen peroxide. Complete recovery from her symptoms occurred quickly with hyperbaric oxygen therapy. **Conclusion:** This is a case report of the successful use of hyperbaric oxygen therapy to treat portal venous gas embolism caused by hydrogen peroxide ingestion. Hyperbaric oxygen therapy can be considered for the treatment of symptomatic hydrogen peroxide ingestion. © 2009 Elsevier Inc.

Keywords—hydrogen peroxide; gas embolism; hyperbaric oxygen; portal vein; computed tomography; HBO

INTRODUCTION

Hydrogen's peroxide concentration can range from 35%, in a common household cleaning product, to 90%, used for rocket fuel (1). The danger of hydrogen peroxide ingestion results from a widespread embolism of oxygen bubbles in the portal vasculature. There are reports in the literature of complications after wound irrigation with hydrogen peroxide during surgery (2,3). We report the case of a 32-year-old woman who accidentally ingested

hydrogen peroxide who was successfully treated with hyperbaric oxygen therapy.

CASE REPORT

A 32-year-old woman with no significant past medical history presented to the local Emergency Department (ED) 1 h after accidentally ingesting hydrogen peroxide. Within several minutes after ingestion, the patient developed severe abdominal pain, nausea, and vomiting. Her family contacted the local poison control center, who referred the patient to the local ED.

Upon arrival in the ED, the patient denied difficulty breathing, but was complaining of severe abdominal pain. She was alert and oriented. The vital signs were normal. The abdomen was soft but with diffuse tenderness. The work-up included a blood count, a basic metabolic profile, blood coagulation studies, and urine analysis, all of which were unremarkable, with the exception of elevated liver enzymes (serum glutamic-oxaloacetic transaminase of 71 U/L and serum glutamic-pyruvic transaminase of 85 U/L). A computed tomography (CT) scan of the abdomen and pelvis with intravenous contrast revealed air in the portal venous system (Figure 1). A decision was made to transfer the patient to the closest hospital with a hyperbaric oxygen chamber for treatment.

Upon arrival at the hyperbaric facility, 30 min away by ambulance, the hyperbaric team was immediately

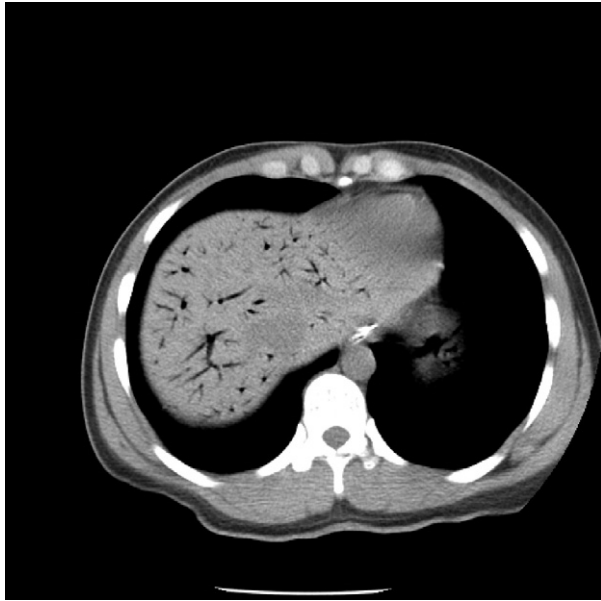


Figure 1. Computed tomography scan shows air in the portal venous system.

consulted and the patient was sent for an emergent hyperbaric oxygen (HBO) treatment. At approximately 5 h post-ingestion and 1 h after arriving at the tertiary care facility, the patient received HBO therapy at 3 atmospheres absolute compression for 3 h.

After HBO therapy, the patient had a dramatic improvement in her symptoms. She had no more nausea or vomiting, and her abdominal pain resolved completely. She was hospitalized for observation and was discharged on the third day after admission. A repeat CT scan of the abdomen and pelvis on the second hospital day revealed complete resolution of the portal venous air (Figure 2). At 1 week outpatient follow-up, the patient continued to be free of symptoms.

DISCUSSION

Exposure to dilute hydrogen peroxide is usually safe and causes only minor irritating effects to the skin and mucosa. There are reports in the literature, however, of cases of acute cerebral and venous gas embolisms caused by accidental ingestion of hydrogen peroxide (4,5). The benefit of the use of hyperbaric oxygen treatment therapy in these settings has been shown. Hydrogen peroxide is broken down to oxygen and water. It dissociates on contact with mucosal surfaces. Thirty milliliters of 35% hydrogen peroxide, if ingested, is enough to produce 3.4 L of oxygen gas (5). Hyperbaric oxygen was shown in

1998 to be of benefit in gas embolism caused by ingestion of hydrogen peroxide (5). HBO therapy works via several mechanisms. It decreases the volume of gas emboli according to Boyle's Law. Further, it increases the solubility of gas into the tissues and plasma. This leads to rapid resolution of vascular occlusion and ischemic or inflammatory injury. Subsequently, the gas is expired through respiration. Just as any treatment involves a risk to the patient, HBO therapy is associated with increased risk of barotrauma (tympanic membrane or sinus), or oxygen toxicity in the form of generalized seizure (in approximately 1:10,000 exposures) (6).

In many cases of hydrogen peroxide ingestion, HBO treatment will not be available. In such cases, placing the patient in Trendelenburg left lateral decubitus position and administering 100% oxygen might be beneficial. HBO treatment might be of benefit even 30 h after the onset of symptoms (7).

In our case, the patient ingested approximately 20 mL of 35% hydrogen peroxide, and approximately 3 L of oxygen gas would have been produced shortly after ingestion. The oxygen bubbles in the portal venous system caused an acute obstruction of the portal vein that resulted in acute inflammatory changes, portal venous hypertension, and bowel edema, causing severe abdominal pain. The effect on the liver can be seen from the patient's elevated liver enzymes. The principle of Boyle's law applies to reducing the size of the bubbles by applying HBO treatment. Our patient's symptoms resolved completely immediately after the HBO treatment. The HBO treatment in this case was empiric and differs from that of a case of decompression sickness, also known as the "bends" (8).

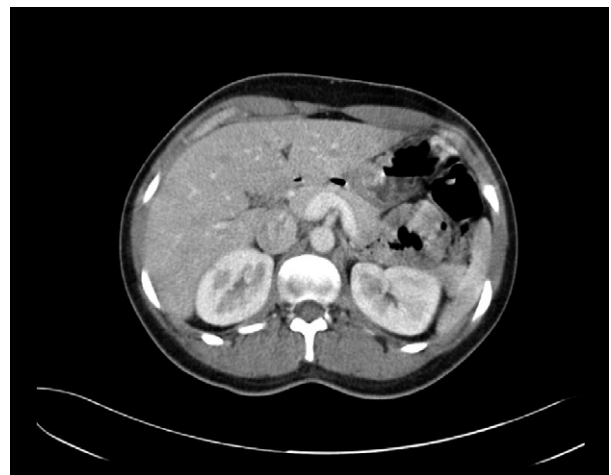


Figure 2. Computed tomography scan shows complete resolution of portal venous gas after hyperbaric oxygen therapy.

In the case presented here, a repeat CT scan after the HBO treatment showed complete resolution of the portal venous gas. This case report demonstrates complete and rapid resolution of symptoms after a life-threatening ingestion of hydrogen peroxide.

CONCLUSION

Accidental ingestion of 35% hydrogen peroxide, a commonly found household item, can have catastrophic results ranging from cerebral gas embolism to portal venous gas embolism, as seen in our patient. Immediate treatment of hydrogen peroxide ingestion should consist of placing the patient in Trendelenburg position, providing 100% oxygen, and arranging for transport to the nearest hyperbaric facility.

REFERENCES

1. Humberson CL, Dean BS, Krenzelok EP. Ingestion of 35% hydrogen peroxide. *Clin Toxicol* 1990;28:95–100.
2. Shaw A, Cooperman A, Fusco J. Gas embolism produced by hydrogen peroxide. *N Engl J Med* 1967;277:238–41.
3. Morikawa H, Mima H, Fujiita H, et al. Oxygen embolism due to hydrogen peroxide irrigation during cervical spine surgery. *Postgrad Med J* 1982;58:448–50.
4. Neff SP, Zulueta L, Miller R. Hydrogen peroxide: an unusual cause of arterial and venous gas embolism. *Anaesthesia* 1996;51:683–4.
5. Mullins ME, Beltran JT. Acute cerebral gas embolism from hydrogen peroxide ingestion successfully treated with hyperbaric oxygen. *J Clin Toxicol* 1998;36:253–6.
6. Broome JR, Smith DJ. Pneumothorax as a complication of decompression therapy for cerebral arterial gas embolism. *Undersea Biomed Res* 1992;19:447–55.
7. Dunbar EM, Fox R, Watson B, Akrill P. Successful late treatment of venous air embolism with hyperbaric oxygen. *Postgrad Med J* 1990;66:469–70.
8. James PB. The treatment of decompression sickness. *Schweitz Z Sportmed* 1989;37:109–14.