

## Case Report

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# Cavography with hydrogen peroxide. Accidental injection of hydrogen peroxide into the inferior vena cava

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## Introduction

Hydrogen peroxide ( $H_2O_2$ ) is a strongly hydrogen-bonded chemical compound similar to water. It is colorless but more viscous and with a pungent odor. Hydrogen peroxide is highly unstable and slowly decomposes into water and oxygen with the release of heat. It is additionally a powerful oxidant that in contact with organic matter can cause spontaneous combustion. This molecule has multiple applications in industry and medicine, being used as a general antiseptic, and also has hemostatic action. Its mechanism of action is due to the oxidative action that attacks certain organic tissues. The catalase present in the tissues breaks down hydrogen peroxide releasing oxygen [5].

$H_2O_2$  intoxication is rare and generally has a favorable prognosis, although severe and lethal cases have been described. This substance is widely used in Interventional Radiology operating rooms, so it can be confused with other clear and transparent liquids (saline or contrast). If this substance is not accurately marked, in a moment of oversight, an accidental injection or excessive irrigation of hydrogen peroxide in the organism can be performed.

## Abstract

Contrast cavography during removal of a vena cava filter in patients treated via thrombectomy for pulmonary embolism is a widely performed procedure, which may involve potentially serious complications if the human factor fails. Accidental injection of hydrogen peroxide ( $H_2O_2$ ) after mistaking it for contrast material can have fatal consequences. We present the case of a patient who was accidentally injected with a high quantity of hydrogen peroxide. The preparation of a preoperative checklist, the amount of  $H_2O_2$  injected and the operator's skill in aspirating the substance are decisive factors in avoiding such complications.

If this were to occur, serious complications could arise such as cardiac arrest [1], pulmonary embolism [2,3], and stroke [4].

Hyperoxygenation therapy has also been tried unsuccessfully and with lethal consequences in AIDS and cancer [11,10]. In most of the reported cases, the application of  $H_2O_2$  has been subcutaneous, cavity lavage, or ingestion. However, few cases of direct intravascular injection have been described. We present a patient in whom 35 cc of 3% hydrogen peroxide was accidentally introduced into the inferior vena cava.

## Case report

A 77-year-old male patient, with no known allergies and diagnosed with gallstones pending surgery. The patient presented to the emergency room with syncope and loss of consciousness and profuse sweating without dyspnea. The electrocardiogram showed a cardiac frequency of 113 per minute and a rhythmic pulse without extrasystoles;  $O_2$  saturation <90% with PESI of 137 points, which translates into a very high-risk class V for Pulmonary Embolism (PE). A chest CT angiography was performed that confirmed bilateral PE with high thrombotic load, RV / LV ratio > 1, and TAPSE 13. Troponins T > 176 ng/ml and ProBNP 1254 pg/ml. Submassive embolism was diagnosed with signs of

right cavity overload and elevated cardiac markers, for which thrombolytic treatment and aspiration thrombectomy was performed. Besides, a vena cava filter/ Gunther Tulip (Cook Medical) was implanted in the infrarenal region without incident. The evolution of the patient was satisfactory, normalizing the pulmonary venous pressures without perfusion defects. After 30 days, an outpatient appointment was made to remove the IVF and perform a hemodynamic study.

During the procedure and before cavography, 30 cc of H<sub>2</sub>O<sub>2</sub> was accidentally loaded into a syringe and injected through the extractor sheath of the Cook set (Coaxial retrieval sheath system. Cook Medical Bjaeverskov, Denmark). Hydrogen peroxide was injected at the iliac bifurcation of the IVC (Figure 1A). Immediately, the interventionist noticed that it was not an iodinated contrast but possibly H<sub>2</sub>O<sub>2</sub>, so the sheath was raised to the right atrium and 20 cc of blood were aspirated, obtaining bubbling blood. The patient remained asymptomatic with regular O<sub>2</sub> saturation (O<sub>2</sub> Sat of 98%) and sinus rhythm (ECG at 90 pulses per minute). Serial blood tests were performed at half an hour and six hours after the procedure with no alterations in the biochemical or hematological parameters (Hemoglobin 14 g/dl and total bilirubin 0.23 mg/dl).

After a brief observation pause, the IVC filter was removed and the patient remained stable for 24 hours under observation in the operating room. A follow-up at 3 and 12 months post-procedure was performed and the patient had no respiratory or hematologic pathology (Figure 1B).



**Figure 1:** Cavography was performed before the removal of the vena cava filter. (A) Cavography with an accidental injection of 30 ccs of hydrogen peroxide. (B) Cavography of the same patient with the injection of iodinated contrast.

## Discussion

Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is generally marketed as a colorless, odorless, acidic aqueous substance, in concentrations ranging from 3% to 90% [5]. It is an oxidizing agent that decomposes into oxygen and water in presence of many metals, alkaline solutions, and the catalase enzyme present in organic tissues. It has many applications but the best known in medicine is as a 3% disinfectant/antiseptic. In former times it was used to irrigate wounds and tissues but due to its potential complications, this indication has been declined [6,7].

The toxicity of oxygen peroxide depends on three fundamental mechanisms: corrosive damage, the release of oxygen gas, and lipid peroxidation. The toxicity of hydrogen peroxide depends on the quantity, concentration, and way of arrival. The most common way are inhalation, ingestion, irrigation of highly vascular cavities, and direct intravascular injection. Intravascular injection of hydrogen peroxide has occurred for therapeutic purposes [9-11] and accidentally [8]. In almost all cases the consequences have been fatal, resulting in death. The heme-protein catalase present in red blood cells and other tissues such as bone marrow, kidneys, and liver facilitates a fast breakdown of the hydrogen peroxide bond, producing water and molecular oxygen. The bubbles cause pulmonary and even cerebral arterial embolism, heart rhythm disturbances, and hemolysis. Our patient, who received an accidental injection of 30 cc of 3% hydrogen peroxide, did not show any of the alterations described in the literature. We hypothesized that it could depend on the amount and concentration of H<sub>2</sub>O<sub>2</sub>, as well as the fast maneuver of aspirating bubbling blood from the right atrium with an 11 Fr sheath.

It is known that annually there are between 100.00 and 400.00 annual deaths due to human errors in the USA. 5.3% of these accidents are related to medication errors during surgery [12]. The existence of a checklist, strict rules for the location of the different fluids on the surgical table, and better the separation of the various liquid substances commonly used in Interventional Radiology in color-coded cans: saline, iodine, contrast, hydrogen peroxide, can avoid human errors that can have fatal consequences.

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