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Case Report: Aspiration Pneumonitis as a Rare Complication Following Hydrogen Peroxide Intoxication

Maulinda Putri[1], Suhartomi[2*], OK Yulizal[3], Siti Syarifah[4]
[1]Faculty of Medicine, Institut Kesehatan Medistra Lubuk Pakam. Deli Serdang, Indonesia
[14]Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia
[23]Faculty of Medicine, Dentistry, and Health Science, Universitas Prima Indonesia, Medan, Indonesia

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ABSTRACT

Introduction: Suicide rates continue to rise globally, with self-poisoning being a common method in some developing countries. This report reported a case of hydrogen peroxide ingestion leading to aspiration pneumonitis, a less-discussed complication compared to gastrointestinal toxicity. ***Case Illustration:*** A 41-year-old woman presented to the emergency unit 8 hours post-ingestion of a hydrogen peroxide-based toilet cleaner. Symptoms included vomiting, hoarseness, faintness, and frothing at the mouth. The physical examination revealed dyspnea, irritability, a cleaning solution odor in the oral cavity, rhonchi in the middle and lower lung fields, epigastric tenderness, and increased bowel sounds. Gastric lavage with 200 mL of saline was performed, and activated charcoal and sucralfate syrup were administered via a nasogastric tube. The patient had previously received ranitidine at another facility and was also treated with omeprazole and ondansetron. Laboratory results showed leukocytosis, and a chest x-ray indicated bilateral lung infiltration and increased broncho-vascular pattern. ***Discussion:*** Early and proper intervention by trained healthcare professionals, combined with preventive measures such as positioning the patient in a semi-upright position and avoiding emetogenic liquids, is essential. ***Conclusion:*** This case showed the importance of prompt management involving gastric lavage, mucosal protection, acid suppression, and absorption inhibition. Nonetheless, respiratory complications, such as aspiration pneumonitis, remain challenging to prevent.

1. INTRODUCTION

Suicide increases every year over the world, like a communicable disease. An estimated 700,000 to 800,000 people die by suicide, which means one in 40 people commits suicide. World Health Organization (WHO) also reported that the global annual mortality rate was 10.7 per 100,000 people, which depends on various age groups and countries. It has become a trend for an alternative way for some people to resolve their problems. Around 45,000 deaths are reported each year in the United States, and most of these suicide cases are due to firearms.[1–3]

Some previous studies have investigated the reasons people commit suicide, which can be financial problems, heartbreak, social discrimination, et cetera. Moreover, some methods used to commit suicide include hanging, poisoning, jumping into a well/river/ravine, burning, stabbing, and vein cutting. Some factors can affect the methods of suicide, which are social-demographic characteristics like financial and social strata reasons. In the developed country, due to firearms ownership policy, the most common method of suicide is firearms. Furthermore, these methods can be classified into non-violent (drugs and poisons) and violent methods.[4,5]

One of the non-violent suicide methods is intentional self-poisoning, which occurs commonly through the utilisation of prescribed medication, over-the-counter drugs, chemical agents, or illicit drugs. Intentional ingestion of corrosive agents as a suicide method is not a rare case. The most commonly ingested chemicals are either strong acids or bases, which can penetrate the

*Corresponding author
E-mail addresses: suhartomi@unprimdn.ac.id

various layers of the oesophagus, but other chemicals, such as weak acid or concentrated acetic acid, can also cause oesophageal injury. [5,6] Around 5.8% of the Italian male population dies every year due to toxic poisoning, that was a lower percentage than women (12.1%). It is worth noting that ingestion of corrosive substances is more prevalent in children due to their tendency to consume such substances unintentionally. In contrast to adults, children may sometimes intentionally ingest corrosive substances intending to commit suicide, which can potentially lead to more severe damage to the gastrointestinal tract and oropharynx. Several pathological changes can occur in the gastrointestinal tract because of the ingestion of a corrosive substance. These can include stricture and perforation. In advanced cases, it can be greater extents to multiorgan system failure, disseminated intravascular coagulation, and sepsis.[6–8]

Some corrosive substrates can be encountered daily as a base or acid, such as hydrochloric acid (HCl), sodium hydroxide (NaOH), ammonia, potassium hydroxide, or sodium hypochlorite. Other chemicals that may also be found in households include paraquat, phenol, potassium permanganate, mercury chloride, or zinc chloride. Either acid or base substrate only injures mucosal layers. Moreover, either strong acid (pH < 2) or strong base (pH > 12) extensively damages oesophageal, which induces colliquative (base) or coagulative (acid) necrosis.[8]

Hydrogen peroxide is the simplest form of peroxide. It acts as a strong oxidiser and a weak acid in aqueous solution. Hydrogen peroxide is commonly used as a commercial product in aqueous solution concentration of 3% to 90% (weight/ weight).[9] It is widely utilised in several household, medical, and industrial facilities due to its oxidising properties. Hydrogen peroxide solution has a clear appearance and is relatively odourless in less concentration, which makes it easily mistaken for water, resulting in accidental ingestion, especially when it fills in an unlabelled bottle. Three per cent hydrogen peroxide is used for household purposes and is unlikely to cause significant harm if ingested unintentionally. Meanwhile, oxygen can be released at higher concentrations of hydrogen peroxide (35%).[10,11] Ingestion of hydrogen peroxide can cause a spectrum of clinical presentation from completely asymptomatic to life-threatening, such as hollow viscous perforation and gas embolism. Hydrogen peroxide can be absorbed into the body through the gastrointestinal tract, respiratory tract, and integument. It is commonly absorbed in the gastrointestinal tract for most poisoning cases. Three mechanisms of hydrogen peroxide poisoning include corrosive damage, oxygen gas formation and lipid peroxidation.[12] Ingestion of large quantities of high concentration (> 35%) can cause gastrointestinal tract injury and oxygen formation from catabolism that leads to gas embolism in the portal vein and cerebral embolism. The gas embolism is commonly reported in the ingestion of high-concentration hydrogen peroxide, and it rarely causes serious damage in lower concentrations (3%). [13]

Some patients with minor injuries due to corrosive ingestion recover without any serious complications. However, some patients with serious chemical injuries can not recover and suffer from high complications and mortality. Acute symptoms of corrosive ingestion can affect the gastrointestinal or respiratory tract, including pneumonia, respiratory failure, bleeding, and perforation. Around twenty-nine per cent of corrosive ingestion, especially in a paediatric population, developed some medical complications from corrosive ingestion, including chemical pneumonitis, atelectasis, aspiration pneumonitis, and dysphagia associated with gastroesophageal reflux. Most corrosive cases can cause death by tracheal necrosis and oesophageal or gastric perforation, followed by mediastinitis or peritonitis. [6,8]

According to the information above, the suicide case rate is high worldwide, with self-poisoning by ingestion of corrosive substances being a common method. Rapid treatment in emergency units can improve outcomes and save lives. However, managing such cases remains challenging, often requiring interventions and prolonged recovery. In this case report, we present a patient with hydrogen peroxide ingestion complicated by aspiration pneumonitis. While most case reports focus on the gastrointestinal toxicity of hydrogen peroxide, reports on aspiration pneumonia are rare and often diagnosed late, highlighting the importance of awareness and early recognition.

2. CASE ILLUSTRATION

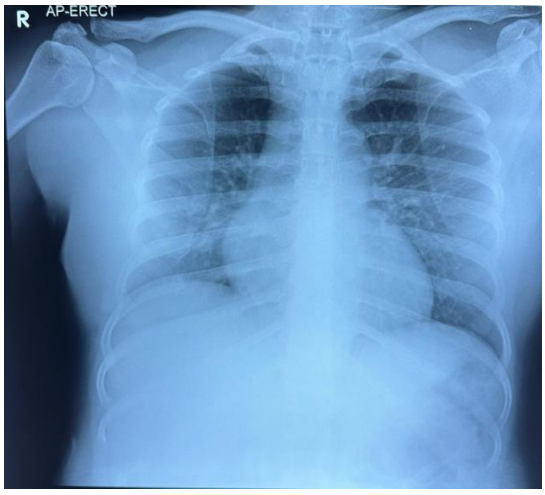
A woman aged forty-one years old was referred to the emergency unit of a hospital in Medan, Sumatera Utara, Indonesia, with a chief complaint of vomiting within 8 hours before the patient came to the referring hospital. The patient has experienced it with a frequency of three to four times and a volume of three hundred millilitres. Vomitus began around fifteen minutes after the patient swallowed around two hundred millilitres of toilet cleaning solution that contained 17% hydrogen peroxide based on the cleaner label. Before the patient vomited, the patient had an episode of hoarseness, faint, and frothing mouth. According to the patient's family, the patient swallowed toilet cleaner after discovering that her son was involved in a recurring conflict with his brother. In addition, the patient also complained of heartburn and burn sensation in the epigastric region. The patient did not have any past medical or treatment history. The patient did not have any past medical or treatment history. Furthermore, the patient's family also said that the patient had no diseases or medications before.

On submission, the patient also looked dyspnoeic and irritable, and the physical examination of the patient for generalist status revealed that vital signs within the normal range, including systolic blood pressure of 140 mmHg, diastolic blood pressure of 87 mmHg, pulse rate of 98 beats per minute, respiratory rate of 26 breaths per minutes, axilla temperature of 36.5^{o}C, and peripheral oxygen saturation around 98% in room air. Other physical examinations showed the smell of toilet cleaning solution, rhonchi in both lung fields (middle and lower lungs), epigastric tenderness, and increasing bowel sounds. Moreover, this patient also has been intubated by a closed-system nasogastric tube.

At a previous health center, the patient underwent an initial assessment and received treatment for an emergency condition. The initial evaluation and management followed the Airway, Breathing, Circulation, Disability, and Exposure/Environment (ABCDE) approach. The patient received an intravenous fluid replacement with ringer lactate solution (20 drops per minute), oxygenation via nasal cannula with rate of 2-4 litres per minute, and nasogastric tube intubation. This patient also received some medications, including an intravenous injection of 50 milligrams of ranitidine and 4 milligrams of ondansetron. On the other hand, the patient also received ten tablets of active charcoal tablet and two tablespoons (30 millilitres) of sucralfate via nasogastric tube.

Furthermore, a previous health centre has also performed some investigations, including complete blood count, randomised blood glucose level, and rapid test for COVID-19 antigen. The complete blood count showed increased leukocytes (11,940 cells per microliter), normal haemoglobin (12 grams per decilitre), and normal platelets (466,000 cells per microliter). Blood glucose level was within normal range (80 milligrams per decilitre), and the rapid test for COVID-19 antigen also showed a negative result..

Figure 1.
Chest X-ray in anterior-posterior (AP) position



In the recent emergency unit, the patient underwent a gastric lavage with two litres of normal saline and was placed in a 40° head up position. Some additional medications include intravenous injections of 10 mg metoclopramide, 500 mg tranexamic acid, 2 mg phytonadione, and 40 mg omeprazole. Moreover, this patient also underwent additional investigations, including a chest x-ray, repeated complete blood count, and kidney function test. Chest X-Ray showed bilateral infiltration and increasing bronco vascular pattern on middle-lower lungs; this Chest X-Ray can be seen in Figure 1. Repeated blood count showed a decrease in haemoglobin to 10.9 milligrams per decilitre, an increase of leukocytes into 16,260 cells per microlitre, and a normal range of platelets. The differential count also showed an increasing neutrophile to 91.60%. To identify the cause of the decreased haemoglobin, this study also analysed the erythrocyte profile, including the mean corpuscle volume (MCV), the mean concentration of haemoglobin, and the mean corpuscle of haemoglobin concentration (MCHC). The results indicated that these values were 69 femtoliters, 21.6 picograms, and 31.1 grams per decilitre, respectively. Finally, the kidney function test including serum urea, serum creatinine, blood urea nitrogen, estimated glomerular filtration rate (4-Variable Modification of Diet in Renal Disease) that were 23 milligrams per decilitre, 0.59 milligram per decilitres, 10.7 milligrams per decilitre, and 112.3 ml/ min/ 1.73 m^2, respectively.

Unfortunately, the patient chose to be discharged against medical advice (AMA) without providing specific reasons within 48 hours after admission to referral hospital, despite the prognosis of the disease being *dubia ad malam*. This decision further exacerbated the situation, increasing the risks of respiratory failure, recurrent aspiration, and repeated ingestion.

3. DISCUSSION

Aspiration pneumonitis is characterized by immediate hypoxemia, fever, tachycardia, and chest X-ray abnormalities, resulting from the macro-aspiration of harmful liquids. It should be distinguished from aspiration pneumonia, which is an acute lung infection that occurs following the aspiration of large volumes of oropharyngeal or upper gastrointestinal contents. The aspirated material in aspiration pneumonia is often not acidic enough to induce chemical pneumonitis. In contrast, the harmful liquids involved in aspiration pneumonitis are typically sterile gastric contents, though they may also include bile or other substances introduced through the stomach.[14] This case report reported a case of hydrogen peroxide ingestion concomitant with aspiration pneumonitis, highlighting a common noxious liquid that can cause this condition.

The patient's clinical presentation aligns with the characteristics of aspiration pneumonitis. The history of hydrogen peroxide ingestion, followed by vomiting and frothing at the mouth, suggests a high risk of macro-aspiration. The presence of dyspnea, irritability, and abnormal lung sounds further supports pulmonary involvement. Additionally, the chest X-ray findings of bilateral lung infiltration and an increased broncho-vascular pattern indicate a chemical insult to the lungs. Given that aspiration pneumonitis typically results from the inhalation of harmful liquids, such as corrosive substances, this case strongly suggests the diagnosis of aspiration pneumonitis secondary to hydrogen peroxide ingestion.

Hydrogen peroxide affects not only the gastrointestinal tract but also the respiratory tract. Aspiration of oxidative compounds can occur due to vomiting that occurs after accidental ingestion. Hence, early aspiration of strong acids during ingestion might occur concomitantly with pulmonary sequelae. The most common form of pulmonary sequelae is pneumonitis caused by gastric juice aspiration or acid ingestion-related aspiration, which is rarely reported. [15–18] The history taken in this study described the cause of the patient's disease and the aim of the ingestion. The patient intentionally ingested hydrogen peroxides due to a family stressor, and it was aimed for suicide purposes. Hydrogen peroxide is a common chemical used in daily life, medical, and industrial facilities, and it can be found in 3% to 90% hydrogen peroxide in aqueous solution.[9] It can easily be found in daily life products like toilet cleaners, which have a clear appearance and are relatively odourless and in less concentration. It is, therefore, understandable that it can be mistaken for water, resulting in accidental ingestion, especially when it is filled in an unlabeled bottle. Hydrogen peroxide is frequently used for non-violent suicide methods, especially in developing countries among low social strata communities.[5,6,10,11] Hydrogen peroxide solution has

a clear appearance and is relatively odourless in less concentration, which makes it easily mistaken for water, resulting in accidental ingestion, especially when it is filled in an unlabelled bottle. Three per cent hydrogen peroxide is used for household purposes and is unlikely to cause significant harm if ingested unintentionally. Meanwhile, higher concentrations (35%) can release oxygen.[10,11]

Both aspiration pneumonitis and pneumonia commonly found in hospital environments. Gastric aspiration has been reported as a complication of general anesthesia in approximately 1 in 2,000 to 30,000 procedures. More recently, the incidence has been estimated at 3 cases per 10,000 general anesthesia procedures, particularly in special populations and emergency situations. On the other hand, aspiration events are also frequently reported in ICU settings. An estimated 88.9% of ICU patients have experienced at least one aspiration event, based on bronchoalveolar lavage levels of pepsin.[14] Thus, it is evident that the incidence of aspiration pneumonitis is relatively rare when the most of aspiration pneumonitis case found in hospital.

Two phases are occurred after ingestion of corrosive contents, which are a direct corrosive effect to respiratory tract epithelium and a neutrophile inflammatory responses. These phases lead to various clinical presentations including coughing, fever, hypoxia, bronchospasm, wheezing, and crackles.[14,19] Based on the concentration of ingested hydrogen peroxide concentration, it can cause a spectrum of clinical presentation from completely asymptomatic to life-threatening, such as hollow viscous perforation and gas embolism. Hydrogen peroxide can be absorbed into the body through several routes, including the gastrointestinal tract, respiratory tract, and integument. It is commonly absorbed in the gastrointestinal tract for most poisoning cases. Three mechanisms of hydrogen peroxide poisoning include corrosive damage, oxygen gas formation and lipid peroxidation.[12] Ingestion of large quantities of high concentration (> 35%) can cause gastrointestinal tract injury and oxygen formation from catabolism that leads to gas embolism in the portal vein and cerebral embolism. The gas embolism is commonly reported in the ingestion of high-concentration hydrogen peroxide and it rarely caused severe damage in lower concentrations (3%).[13] Moreover, severe aspiration pneumonitis can also result in Acute Respiratory Syndrome (ARDS).[14,19] Consequently, diagnosing aspiration pneumonitis can be challenging; however, it is typically diagnosed based on clinical presentation and radiological findings.

This case report reported that the patient had a frothing mouth after ingestion of hydrogen peroxide, which potentially caused the aspiration pneumonitis. Aspiration pneumonitis is also demonstrated as an infiltration of the lung in a chest x-ray. The patient also complained of vomiting, burn sensation, and heartburn. Some factors have been reported to cause some patients to suicide. In this case report, the patient committed suicide by self-poisoning due to his son's conflict. It seems likely that this method of suicide was selected for financial and social reasons that did not require a significant financial investment. In addition, patients think it is a non-violent suicide method; however, it can cause prolonged complications.[4,5] Burn sensation and heartburn indicate an inflammation sign, a burning sensation in epigastric pain indicates the inflammation in gaster tissue, and heartburn indicates the inflammation in the oesophagus as an impact of the reflux process. Meanwhile, vomitus is caused by increasing gas volume in the gaster that induces extrusion of the gaster juice. This gas volume comes from the hydrogen peroxide oxidation reaction, which produces oxygen gas and water.[12,16,20] Furthermore, the physical examination also showed rhonchi in both lung fields (middle and lower lungs), infiltration in chest x-ray, and leukocytosis, that were supported the possibility of aspiration pneumonitis.

Immediately after ingesting hydrogen peroxide, the patient in to emergency unit to the emergency management. This management included hydrogen peroxide dilution by normal saline via nasogastric tube, administration of a proton pump inhibitor, and a histamine-2 receptor antagonist. Activated charcoal was also given to absorb the hydrogen peroxide, aiming to reduce its absorption and mitigate oxygen release. Instead of a targeted therapeutic intervention, the patient received supportive clinical care, which included airway suctioning to maintain patency, oxygen therapy to correct hypoxemia, and mechanical ventilation if necessary. These emergency management align with the recommendations outlined in the literature review by Neill and Dean (2019).[21]

This case study reported the ingestion of 17% hydrogen peroxide, which has weak acid and strong oxidiser. The patient received around two tablespoons of sucralfate, which reacts with hydrogen peroxide, a weak acid, to form a viscous, tenacious pasta that binds selectively to ulcers or erosion for up to 6 hours.[22] The patient also received a large amount of normal saline via a nasogastric tube aimed at diluting the hydrogen peroxide. The patient ingested around two hundred millilitres of 17% hydrogen peroxide and was diluted into two litres of normal saline, which was diluted it from 17% to 0.85%. This gastric lavage is still in line with the Indonesian Society of Internal Medicine, cited from the EIMED PAPDI book, which is aimed to reduce the corrosive property (corrosive damage, oxygen gas formation, and lipid peroxidation) of ingested hydrogen peroxide. In this case report, the patient used sucralfate to neutralise the acidic properties of hydrogen peroxide and diluted it by normal saline to reduce the concentration of hydrogen peroxide.[12,15,23]

This case report also reported that the patient received both ranitidine and omeprazole. This combination was used because of the different regulations of each health centre. These drugs have a synergic drug interaction. Hence, the dose of omeprazole as a drug of choice for gastrointestinal injury is administrated in half of the recommended dose due to the administration of prior ranitidine. However, the Indonesia Society of Internal Medicine in the EIMED PAPDI book recommended using proton pump inhibitors over H2 blockers in ceasing gastrointestinal bleeding due to its efficacy.[23,24] Moreover, this case report also reported the usage if active charcoal to adsorb ingested toxins within the gastrointestinal tract to prevent systemic absorption of that toxin, which was in line with the recommendation of Indonesia Society of Internal Medicine, in the EIMED PAPDI book. Activated charcoal only absorbs toxins in the dissolved liquid phase via direct contact. Activated carbon decompose hydrogen peroxide by exchanging a hydroxyl oxygen group and a hydrogen peroxide anion. Hence, the patient, in this case report, received activated charcoal to decompose hydrogen peroxide to adsorb it and prevent systemic absorption of hydrogen peroxide along the gastrointestinal tract.[23,25,26]

The prognosis in this case was *dubia ad bonam*, consistent with the mortality and morbidity rates reported in previous studies. Aspiration pneumonia often requires hospitalization, ICU care, and is associated with a higher comorbidity index compared to Community-Acquired Pneumonia (CAP) patients. Furthermore, a meta-analysis revealed that the risk of in-hospital mortality for patients with aspiration pneumonia is 3.63 times higher than for those with CAP (95% CI: 2.65–4.96). The 30-day mortality rate is similarly elevated, at 3.57 times higher (95% CI: 2.18–5.86). These findings highlight the potential for the patient's condition to worsen significantly, particularly after the decision to discharge against medical advice (AMA).[27]

4. CONCLUSION

Overall, it seems reasonable to conclude that the patient suffered from hydrogen peroxide ingestion and aspiration pneumonitis. It may, therefore, be beneficial to consider the possibility of early management of hydrogen peroxide ingestion to prevent further respiratory involvement. Although early management for gastrointestinal decompensation—including procedures such as gastric lavage, mucosal protection, acid suppression, and inhibition of systemic absorption—is associated with an increased risk of aspiration pneumonia, when performed correctly by trained healthcare professionals, these interventions can prevent aspiration pneumonia. Furthermore, additional preventive measures—such as positioning the patient in a semi-upright position and avoiding the administration of liquids that may trigger vomiting—can further reduce this risk.

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