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Accidental Ingestion of Nitric Acid in an Agricultural Company: A Case Study and Literature Review

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Abstract

Introduction: Though common in society, caustic accidental ingestion is rare in the agricultural industry. This study describes a case of ingestion of nitric acid used as an agricultural fertilizer by an ordinary worker at the Société de Cultures Légumières. **Clinical Case:** This is a 33-year-old unschooled woman who ingested a sip of nitric acid from an abandoned labelled acid canister near a farming plot of land. She showed a burn of the oral cavity with a bleeding tablecloth and an intense retrosternal pain. The duodenal oesophagus fibroscopy screening that was carried out 18 hours after the accident, revealed an esophagitis class 2b. The tests revealed no anomalies. Fifteen (15) days after the accident, the FOGD was normal. Following an 8-month-follow up, no signs of stenosis or degeneration were noted. **Conclusion:** The accidental ingestion of nitric acid is rare in adult. Its treatment is mainly symptomatic and aims at preserving vital functions without directly fighting the ingested substance off. The right actions must be integrated into the 15-minute Health and Safety awarenesssessions for optimum pre-hospital management. The hospital evaluation is mandatory and is carried out thanks to the digestive endoscopy, which is still relevant in this indication, but is completed by the thoraco-abdominal CT. The latter is very sensitive the transmural necrosis diagnosis.

Keywords

Accident, Agriculture, Caustic, Fibroscopy, Senegal

1. Introduction

Nitric acid is a very strong acid [1] [2]. It is a colorless liquid with a pungent smell and corrosive properties. It is well-known since ancient times, especially among leather engravers who called it *aqua fortis* or powerful water [3] [4]. It is used in farming to acidify the soil and/or for production with ammonium nitrate ammonia which is the most used mineral fertilizer today [5]. It is a dangerous substance [1] [4] [6]. Accidents involving nitric acid mostly occur in the industry [7]. Ingestion of nitric acid is rare, and its consequences are often dramatic. In France, among 3544 ingestions of caustic, between January 2010 and December 2019, only 221 involved acids, including nitric acid [8]. It was also the case in some African countries like Mali [9]. In Senegal, the caustic ingestion is said to be underestimated, due to poor notification systems. Twenty-two (22) cases were recorded in 8 years in Dakar [10].

In the agricultural industry, especially in Senegal, accidents involving ingestion of caustic are rare [11]. In fact, this is mainly because current regulations and procedures in the handling of crop protection products and fertilizers are carried out in closed circuits and by only trained personnel.

With the patient agreement, we describe as case of nitric acid ingestion by an ordinary worker in open field.

2. Clinical Case

The patient is an unschooled 33-year-old women, who has been working as ordinary laborer for five years. She was admitted for accidentally swallowing one sip of nitric acid in the farm.

Using the Root-cause Analysis Approach, it was found out that illiteracy, inaccuracy of the procedure, failure to report a hazard, and sudden changes of instruction forms, are the main causes of the accident. Nitric acid is a product under strict control. There is no stock outside the central warehouse and the quantities released from the warehouse are normally all used. This properly labelled acid can was abandoned beside a plot of land.

On admission, she was agitated and hemodynamically stable. All vitals were normal apart from a regular tachycardia of 103 beats per minute. She was suffering from intense retrosternal pain.

There was obvious burning of the oral cavity with a lip and cheek ulcer actively bleeding in sheets and hypersialorrhoea. The respiratory status was good and no signs regarding pulmonary auscultation.

She was admitted immediately, and her mouth was rinsed several times with clean water, placed in a half-seated position, and on a strict diet. She received a bolus of 80 mg of Omeprazole as a direct intravenous injection and then rushed to hospital where she underwent her first fibroscopy at H18 following the incident. The fibroscopy revealed Zargar grade 2a caustic oesophagitis. The gastric mucosa was free of any lesions. The thorax X-ray was normal, as were the biology tests, specifically the blood ionogram. A strict diet was maintained for 96

hours. Drug administration included: SG 5% (1.5 L per day) SSI (1.5 L per day) and Omeprazole injection (80 mg per day in two doses). The patient did not undergo a CT scan.

On Day 15 of the accident, a new FOGD was performed, and revealed that the oesophageal mucosa had been restored *ad integrum*.

After 11 months, the patient developed no sequelae, and no stenosis or degeneration was found.

3. Discussion

Nitric acid is a caustic substance. In other words, it can destroy tissues by direct contact immediately or more gradually, leading to tissue necrosis [2]. The ingestion of nitric acid has been described in the Nitric Acid Poisoning Treaty, since the early nineteenth century [4]. Accidents involving ingestion of caustic are increasingly rare but have potential serious consequences [12].

There are typically two groups at risk: 2 - 6-year-old children who accidentally drink caustic products, mainly household products; and 30 - 40-year-old adults who drink large quantities of corrosives with the intention to commit suicide [1] [13]. It is in fact exceptional to find accidental ingestion of a caustic by an adult, which is what makes this study so specific. In Israel, Y. Lurie described 23 cases of caustic ingestion in adults in 12 years, 78.3% of which were intentional [14]. In Australia, Timothy Cowan's review of caustic ingestion found a total of 86 adult patients over 27 years, admitted for caustic ingestion. Among them, 48% were done for autolysis purpose [15]. In Africa, despite poor reporting systems, the authors agree that the prevalence of caustic ingestion has not fallen significantly [1] [16]. In Nigeria, for example, over a period of 7 years, there were 28 cases of caustic ingestions, including 21 adults. Again, more than 70% of these ingestions in adults were attempted autolysis [16]. In Dakar, 25 cases of caustic ingestion were recorded in 8 years, representing a prevalence of 0.9% in the hepato-gastroenterology department of the Hôpital Général Idrissa POUYE, with 64% of these cases being self-inflicted [10].

Acid is the most frequent substance involved in cases of caustic ingestion in Europe and Asia and in some African countries [1] [14] [17]. But in Senegal and many other West African countries, caustic soda was in the forefront due to its accessibility and widespread domestic use [10] [13] [18]. In the agricultural industry, we have not found any cases of accidental or deliberate ingestion of caustic soda.

When nitric acid or any other strong acids (pH < 1) are ingested, there is coagulative necrosis of the esophageal mucosa. This reduces its absorption and minimizes damage. Within the first few hours, there is a formation of eschar and the fluid rapidly flows into the stomach, where pyloric spasm prolongs the contact time between the acid and the gastric mucosa [1] [19]; then, around day five, a healing process begins which starts with fibrin deposition on the ulcers [12] [19]. Clinically, presentation is poor, depending on the quantity of acid, whether

or not it is associated with inhalation. It is often limited to burning pain in the oral, retrosternal and gastric cavities, laryngeal dyspnea, and respiratory distress, but doesn't augur any severity of the lesion [19].

In our case, pre-hospital care was a strict diet, rinsing of the oral cavity with drinking water, conditioning including peripheral venous line, administration of 80mg a proton pomp inhibitor, half-sitting position, continuous monitoring of vitals, alerting the SAMU National (the emergency medical assistance of Senegal) and the National Anti-poison Center, formal identification of the ingested product, and determination of the accidental nature of the ingestion.

Early treatment is crucial in case of ingestion of caustics, especially acid. The aim is to prevent any worsening of the lesions and to preserve vital functions [1] [19]. Consultation times range from a few hours to several days [10] [19]. In Dakar, the earliest consultations were within the first 30 minutes, with an average delay of 5 hours.

In studies carried out in Senegal and Benin, no vomiting maneuvers were performed. But in Nigeria, Thomas found 60% of patients had attempted maneuvers to vomit. In fact, gastric lavage and emesis provocation are contraindicated, as there is the risk of inhalation and aggravation of esophageal lesions [1] [19].

On the other hand, the use of traditional medicines is still persistent and considerably frequent. In Benin, 100% of patients in Stanley's study took palm oil as an antidote [13]. It is the same in Nigeria [17]. Palm oil is widely used as a remedy to deactivate the effects of the substance. However, these same studies revealed no benefit from this so-called remedy. On the contrary, this can be dangerous and counter-productive to ingest these so-called remedies [1] [19]. A strict diet would be the best approach [1] [12] [13]. Similarly, the administration of antiacids and PPIs as in our case, would be of no benefit [19]. Corticosteroids also remain controversial.

At the hospital, the oesogastroduodenal fibroscopy (OGDF) was performed after 18 hours. For a long time, OGDF remained for a long time the reference examination in this clinical picture [1] [10] [13] [18]. Endoscopy provides a classification that predicts systemic complications, nutritional autonomy, and acute mortality. It can also predict sequelae such as stenosis.

The Zargar classification [20] [21] is most widely used. It is performed in the 6 - 24th hours, when no digestive perforation is suspected [21]. Our patient presented a lesion classified as 2a. This is a frequent level found in studies in Senegal and Nigeria [10] [17] [18]. As in our case, control OGDF of these lesions were often normal.

However, endoscopy has some shortcomings. The most important is its lack of precision in determining the depth of necrosis, which is an important criterion for surgery [1].

CT has therefore become the preferred choice for this indication, thanks to its many benefits. It provides the best emergency results to decide whether or not to undergo treatment or not [1] [8] [22]. Transmural necrosis, better assessed on

CT, is the crucial element that endoscopy cannot assess accurately [22] [23]. The correlation between absence of contrast and transmural necrosis is strong. In addition, endoscopy did not alter the indications based on CT alone [1] [22]. CT has thus become the golden standard in the evaluation of caustic lesions, and has endoscopy in decision-making algorithms [24]. Some authors, however, believe that endoscopy should be preferred in the first few hours [14] [23].

General symptoms are rare, except in cases of massive ingestion. In the case of acid, hypocalcemia has been described in the literature [1] [23].

4. Conclusion

Accidental ingestion of nitric acid is rare in adults. Its treatment is mainly symptomatic, aimed at preserving vital functions without directly fighting the ingested substance off. The appropriate actions must be integrated into the 15-minute health and safety awareness to ensure optimal pre-hospital care. The ingestion of acid or any other caustic can be extremely serious if it is a large quantity. It is therefore critical to carry out an initial assessment in hospital. This diagnosis is made possible by digestive endoscopy, which is relevant in this indication, supplemented by thoracic and abdominal CT scans, which is highly sensitive in diagnosing transmural necrosis.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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