

A Case and Review of Death Associated with Ingestion of Detergent

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Abstract

We experienced an autopsy case of a death associated with ingestion of liquid detergent. The deceased was an 82-year-old woman who was found dead in her bed room. Autopsy revealed corrosive changes of the mucosal surfaces of the lung. The larynx, trachea and stomach contained mucoid matter with abundant froth. Toxicological investigations detected polyethylene glycol in the bronchus, blood and gastric contents using headspace-gas chromatography/mass spectrometry. Surfactants generally have low toxicity but can cause damage to the mucous membrane of the respiratory tract. We report here an autopsy case of death by suicidal ingestion of liquid detergent with special regard to the histochemical findings of the case study.

Keywords

Liquid Detergent, Suicidal Ingestion, Surfactant, Corrosive Change, Autopsy

1. Introduction

Surface-active agents coexisting with hydrophilic and hydrophobic groups are grossly classified into cationic, anionic, and non-ionic groups. Surfactants are widely used in antiseptics and cleaning products and as spreader and emulsifier in pesticides and in industry. These many compounds generally have been considered to be of low toxicity and to produce few serious effects except in the case of cationic surfactants, but serious symptoms and deaths associated with the ingestion of detergents have been reported [1]-[6]. We describe a case of death from swallowing liquid detergent.

2. Case Report

2.1. History of Present

An 82 years old woman with osteoporosis was found lying dead in her bed room. There was a container of liq-

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uid weak alkaline detergent around her. The bottle of liquid detergent contained a surface-active agent (74 w/w%). She had consumed approximately 350 ml of liquid detergent. The woman had the parasuicidal history of taking massive doses of antipsychotic, antidepressant and hypnotic medicines. Ingestion of liquid detergent was the first time for her suicidal activity. A forensic autopsy was performed about 12 h after her death.

2.2. Autopsy Findings

The deceased was 140 cm tall and weighed 31 kg. Postmortem rigidity was strong at jaw and upper limbs. Slightly purplish-red postmortem hypostasis was evident on the dorsal aspect of her body. The trachea contained a large amount of mucoïd material with foam (Figure 1). The heart weighed 212.2 g, and contained large amounts of dark-red liquid blood in the heart. The left and right lungs weighed 242.9 and 182.6 g respectively. The trachea and bronchi were filled with blood-stained foamy fluid. The stomach and intestine also contained foamy mucoïd material (Figure 2). The esophageal mucosa was discolored (Figure 3). The brain weighed 1228 g and no abnormalities were noted. Histological examination with Hematoxylin and Eosin stain revealed that the lungs were congested and edematous, and the structure of pulmonary alveoli was found to be damaged throughout (Figure 4). Corrosive changes were present on the mucosal surfaces of the stomach (Figure 5). Samples of blood, tracheal and stomach contents were obtained at autopsy.

2.3. Toxicological Analysis

Electrospray ionization (ESI) is especially useful for analyzing ionic compounds, *i.e.*, surfactants, and it is easy to obtain their molecular masses. Liquid chromatography/ESI/mass spectrometry (LC/ESI-MS) permits chromatographic separation of mixtures, detection of compounds lacking remarked UV absorption, specification of

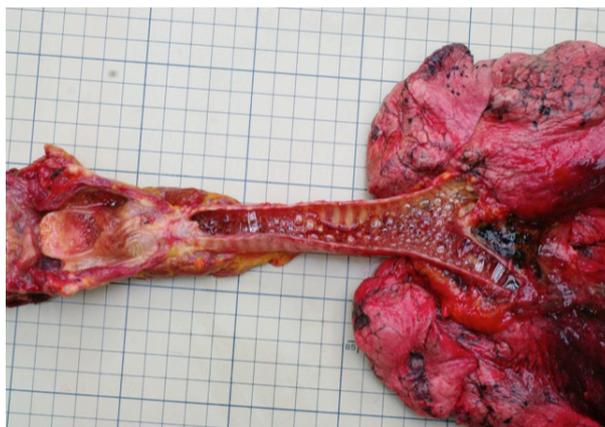


Figure 1. Foamy mucoïd material in the trachea.



Figure 2. Foamy mucoïd material from the stomach.

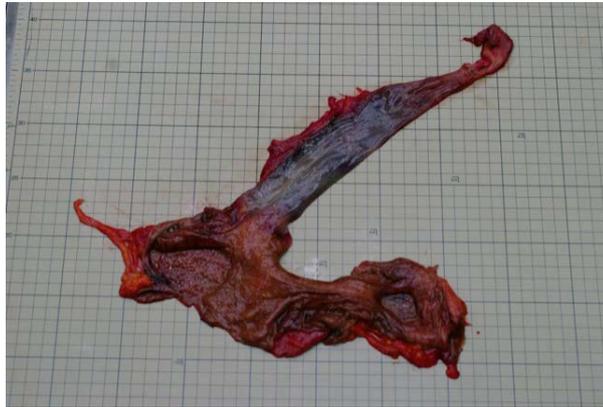


Figure 3. The esophageal mucosa was gray-colored.

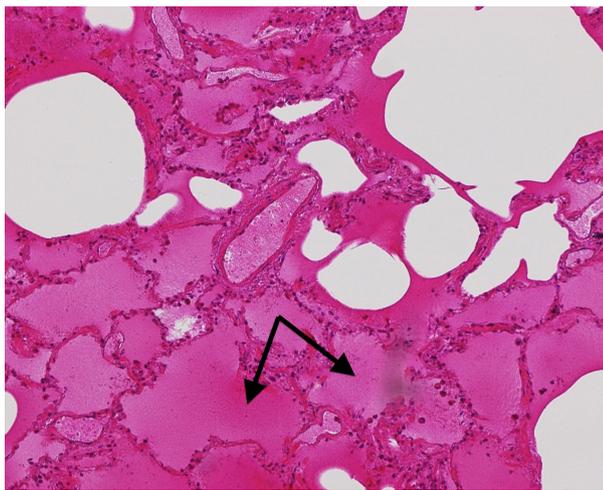


Figure 4. Pulmonary alveoli were congested and edematous (arrow) (Hematoxylin and Eosin staining, magnification $\times 200$).

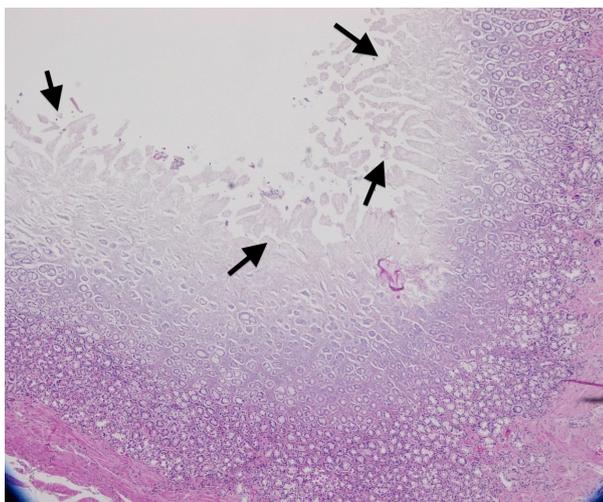


Figure 5. Superficial corrosive changes of liquid detergent on the stomach (arrow) (Hematoxylin and Eosin staining, magnification $\times 200$).

the number of ethyleneoxide (EO) and structure of the alkyl moiety, identification of its group, and further discrimination between commercially available detergent products. We analyzed the blood in this case. LC/ESI-MS was performed on a platform (BRUKER micro TOF II) in negative mode for anionic surfactants and positive mode for cationic and nonionic surfactants. Cross-flow interface as an ion source was set at 200°C. Capillary was set for negative mode and positive mode, respectively. Thermo Hypersil GOLD columns was used (2.1 mm i.d. × 50 mm). A gradient mobile phase system, composed of eluent A (5 mM formic acid ammonium) and eluent B (acetate nitrile), was applied to the column; the concentration of eluent B was linearly increased from 25% to 85% (2%/min) and then maintained for two minutes.

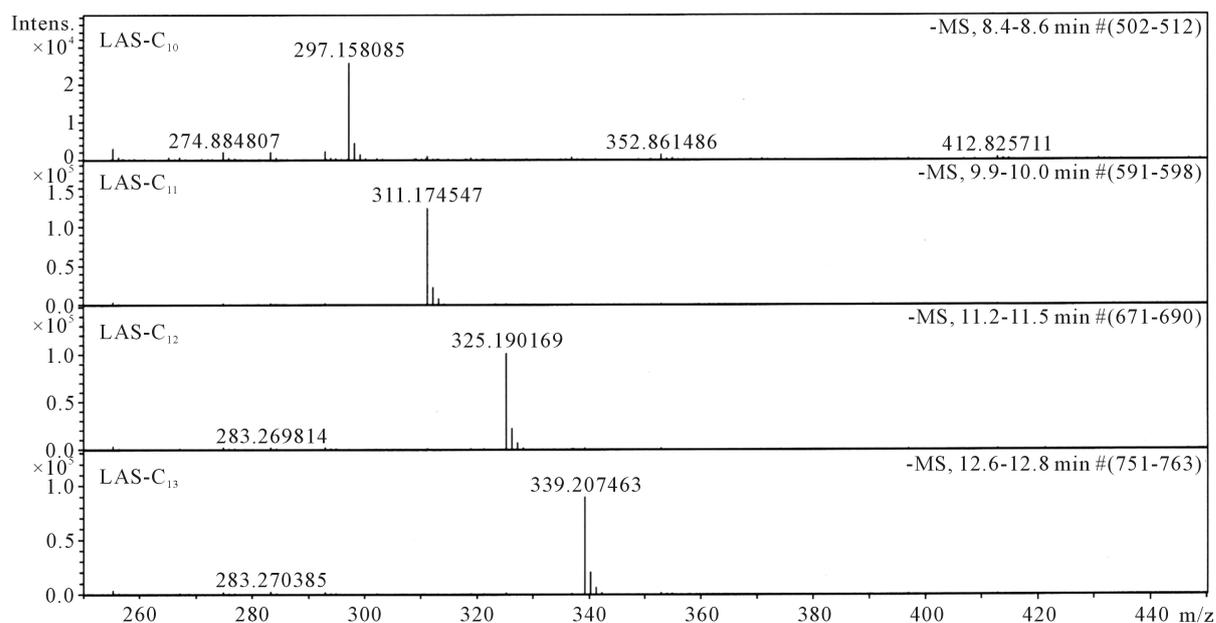
Linear alkylbenzenesulfonate (LAS) negatively charged molecular ions (M-ions) was observed in the negative mode. In the spectrum of LAS plural M-ions appeared, because it was a mixture of compounds that have four different alkyl groups (C₁₀-C₁₃) (Figure 6). C₁₀⁻, C₁₁⁻, C₁₂⁻, and C₁₃-LAS exhibited predominant M-ions at *m/z* 297, 311, 325, and 339, respectively.

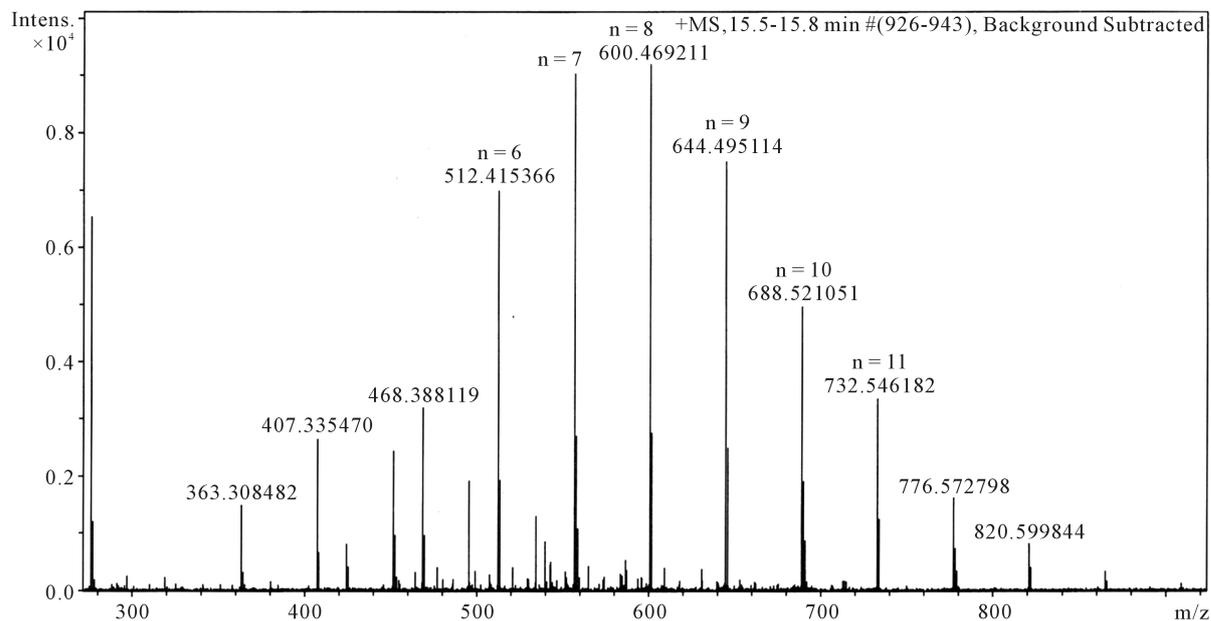
Polyoxyethylene alkyl ether (AE) is one of the most frequently used nonionic surfactants, and its mass spectrum showed the characteristic distribution of the main peaks that were separated by mass units in positive mode (Figure 7). The separation of mass units reflected a difference in the degree of polymerization EO (-CH₂CH₂O-).

3. Discussion

We investigated the component of the liquid weak alkaline detergent. The action of the surfactant against protein of the cell membrane is solubilization and degeneration. When surfactants interact with the cell membrane, the surfactants introduce the membrane lipid or membrane protein into the micelles and destroy the cell membrane. This action is the cause of toxic manifestations [7]. Accordingly, with ingestion of material containing high concentrations of surfactant, disturbance of the mucous membranes in the digestive tract has been thought to be due to a direct corrosive action. Although anionic surfactant has been thought to have low toxicity, several cases of serious symptoms and even death associated with the ingestion of detergent have been reported [1]-[6].

The circumstantial evidence suggested ingestion of liquid detergent, which was confirmed by forensic autopsy, demonstrating detergent in the duodenum and corrosive changes in the mucosal surfaces of the lung. We concluded that the cause of death was due to the suicidal ingestion of liquid detergent. We reviewed cases of associated with ingestion of detergent. There were three autopsy cases in Japan [7]-[9] (Table 1). All three cases were thought to be suicidal. In southern Sri Lanka, the prospective study was reported in self-poisoning with





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Figure 7. Mass spectra of polyoxyethylene alkyl ether in positive mode by flow injection mode.

Table 1. The review of death associated with ingestion of detergent in Japan.

Case	Age	Gender	Component	Product	Year
1	49	M	Anion surfactant and methanol	Liquid windshield-washer detergent	2003
2	65	M	Monoethanolamine (MEA)	Alkaline detergent	2004
3	70	F	Polyoxyethylene alkylether	Liquid anionic laundry detergent	2013

washing powder [10]. The report was that 18 deaths were associated with ingestion of the laundry detergent consisting of potassium permanganate (KMnO_4) and oxalic acid and majority of the deaths occurred within an hour of ingestion. The present case and past reviews of similar cases lead us to emphasize the risk of death following the ingestion of surface-active agents.

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