



Case Report

An autopsy case of fatal repellent air freshener poisoning



Masahito Hitosugi^{a,*}, Chie Tsukada^b, Shinobu Yamauchi^b, Kazumi Matsushima^c, Satoshi Furukawa^a,
Satomu Morita^a, Toshiaki Nagai^b

^a Department of Legal Medicine, Shiga University of Medical Science, Japan

^b Department of Legal Medicine, Dokkyo Medical University School of Medicine, Japan

^c Forensic Science Laboratory, Tochigi Prefectural Police Headquarters, Japan

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ABSTRACT

We describe a first fatal case of repellent air freshener ingestion. A 79-year-old Japanese man with Alzheimer-type senile dementia orally ingested repellent air freshener containing three surfactants: polyoxyethylene 9-lauryl ether, polyoxyethylene (40) hydrogenated castor oil, and lauric acid amido-propyl amine oxide (weight ratio of 1.3%). About 1 h after the collapse, he was in cardiopulmonary arrest and subsequently died 10 h after his arrival. The forensic autopsy performed 5.5 h after death revealed the 380 ml of stomach contents with a strong mint perfume identical to that of the repellent air freshener and the findings of acute death. Toxicologically, 9.1 µg/ml and 558.2 µg/ml of polyoxyethylene 9-lauryl ether were detected from the serum and stomach contents taken at autopsy. Generally, ingestion of anionic or non-ionic surfactants have been considered as safe. However, because the patient suffered from cardiac insufficiency with a low dose of repellent air freshener ingestion, medical staff members must evaluate the elderly patient for cardiac and circulatory problems regardless of the ingested dose. Not only medical and nursing staff members, but also families who are obliged to care for elderly persons must be vigilant to prevent accidental ingestion of toxic substances generally used in the household.

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1. Introduction

Surfactants, which contained in insecticide, herbicide, detergent and so on, decrease the surface tension of these chemicals and improve the ability of adhesions [1]. Surfactant poisonings are often seen in suicide attempts or accidents with the findings of gastrointestinal tract irritation, elevated leukocytosis, or hypotension [2]. In the fatal poisoning cases, cardiovascular collapse and respiratory failure were found [3–9]. Therefore, in forensic medicine, detection of the surfactant from the body fluid or tissues is required for the diagnosis of poisoning death.

Repellents with specific perfumes are widely used in houses and offices. They are in the form of a liquid, of which surfactants are major components. Although fatal surfactant poisoning cases have been reported, there are no reports of repellent air freshener poisoning cases [3–9]. We herein describe a fatal case of repellent air freshener ingestion by an elderly person with senile dementia.

2. Case report

2.1. History

A 79-year-old Japanese man had suffered from Alzheimer-type senile dementia for 5 years. He sometimes orally ingested anything on the table. One day after dinner, the family found that the man had collapsed in the dining room. Beside the man, a bottle of repellent air freshener (Mushiconazuru, Dainippon-jyocyugiku, Osaka, Japan) containing the remaining two-thirds of its liquid contents was found (Fig. 1). Some of the contents had spilled out of the bottle. The air freshener had a mint perfume. Because the man's consciousness did not improve and the family noted a perfume on his face similar to that of the repellent air freshener, they suspected that he had ingested it and transferred him to the hospital. Upon arrival at the hospital, 1 h after the collapse, he was in cardiopulmonary arrest. At the time of intubation, the doctor confirmed a strong mint smell identical to that of the repellent air freshener. Results of the blood examination taken immediately after resumption of the heart beat were as follows: hemoglobin of 11.1 g/dl; total leukocyte count of 13,700/mm³; platelet count of 169,000/mm³. The examination for the serum revealed total protein of 5.6 g/dl; albumin of 2.7 g/dl; creatinine of 0.83 mg/dl, blood urea nitrogen

* Corresponding author at: Department of Legal Medicine, Shiga University of Medical Science, Tsukinowa, Seta, Otsu-City, Shiga 520-2192, Japan. Tel./fax: +81 77 548 2200.

E-mail address: hitosugi@belle.shiga-med.ac.jp (M. Hitosugi).



Fig. 1. Appearance of the repellent air freshener product.

of 8.6 mg/dl; aspartate aminotransferase of 227 IU/l; alanine aminotransferase of 87 IU/l; alkaline phosphatase of 361 IU/l; cholinesterase of 165 IU/l; creatinine kinase of 92 IU/l; sodium of 152 mEq/l; potassium of 4.3 mEq/l; chloride of 102 mEq/l; C-reactive protein of 0.96 mg/dl. Despite treatment, the man was pronounced dead 10 h after his arrival. Because the police suspected that the man had not died of natural causes, a forensic autopsy was performed 5.5 h after death.

2.2. Autopsy findings

The man was 156 cm in height and 50 kg in weight and had been in good general health. No injuries were noted on the body surface with the exception of a few injection marks. No corrosive changes were present on the mucosal surface of the tongue, pharynx, larynx, esophagus, or stomach. A total of 380 ml of material with a strong mint perfume identical to that of the repellent air freshener was found in the stomach. The heart weighed 380 g, and mild left ventricle hypertrophy was present. A stent was inserted into the left coronary artery. Moderate plaque formation with microfibrosis of the surrounding heart muscle was histologically observed. Other than the findings of acute death (fluid blood, visceral congestion, and petechial hemorrhage in the mucosa of the renal pelvis), the autopsy results were normal.

2.3. Toxicologic findings

The repellent air freshener that the man had ingested comprised all 300 ml (full contents) of a bottle of blue liquid with a pH of 5–7. It contained three surfactants: polyoxyethylene 9-lauryl ether (weight ratio of 3.6%), polyoxyethylene (40) hydrogenated castor oil (weight ratio of 1.6%), and lauric acid amido-propyl amine oxide (weight ratio of 1.3%). The other major component was water, which accounted for a weight ratio of about 85%. Because surfactants were considered to be the major toxicologic substances of this repellent air freshener, we analyzed them from the samples taken from the man. Of the three surfactants, polyoxyethylene 9-lauryl ether was dominant, and a standard substance was available. Thus, we quantitatively evaluated the polyoxyethylene 9-lauryl ether in the serum and stomach contents.

Femoral vein blood was taken immediately after arrival at the emergency room, and inferior vena cava blood and stomach contents were sampled at autopsy. Polyoxyethylene 9-lauryl ether, $C_{12}H_{25}-O-(CH_2CH_2O)_9-H$, was obtained from Wako Pure Chemical Industries, Product No. 148-07731 (Osaka, Japan). Calibrators were prepared from a standard solution in drug-free human serum at the following concentrations: 1 $\mu\text{g/ml}$, 2 $\mu\text{g/ml}$, 6 $\mu\text{g/ml}$, and 10 $\mu\text{g/ml}$. The sample was prepared by specimens that were diluted to fall within the range of the calibration curves. Fifty microliters of the sample was added to 0.75 ml of distilled water. The diluted solution was loaded onto an Extrelut NT1 column and retained for 15 min. The column was eluted with 6 ml of diethyl ether, and the elute was evaporated to dryness under nitrogen at 40 °C. The residue was dissolved in 200 μl of acetonitrile, and 3 μl of the extract was injected into a liquid chromatography column after filtration for the performance of liquid chromatography–mass spectrometry (LC–MS).

LC–MS analysis was performed using an Agilent 1200 series LC/MSD SL (Agilent Technologies, Tokyo, Japan). The mobile phase involved 10 mM ammonium formate and acetonitrile. Their rates were 10:90 at 0 min; changed to 5:95 at 5 min and hold for 15 min; changed to 10:90 and hold for 10 min for a total run time of 30 min. An Eclipse XDB-C18 column (3.5 μm , 2.1 \times 150 mm; Agilent Technologies) was used, and the column temperature was set at 40 °C. The flow rate was 0.2 ml/min.

Ionization of analytes was performed using electrospray ionization in the positive mode. The MS parameters were follows: scan range of 100–2000, drying gas flow of 10 L, drying gas temperature of 350 °C, capillary voltage of 2500 V, and fragmentor voltage of 100 V. The calibration curve was linear in the range of 1–10 $\mu\text{g/ml}$. The regression equation was $y = 9.5 \times 10^5 \times -1.6 \times 10^5$ and the correlation coefficient (R^2) for calibration curves was 0.998. For quantitative analysis, the precursor ion m/z 600 was selected because it was the highest intensity of all detected ions.

The serum concentration of polyoxyethylene 9-lauryl ether taken at the emergency room immediately after arriving was 30.1 $\mu\text{g/ml}$, and that measured at the time of the autopsy was 9.1 $\mu\text{g/ml}$. In addition, 558.2 $\mu\text{g/ml}$ of polyoxyethylene 9-lauryl ether was detected from the stomach contents taken at autopsy (Fig. 2).

Neither other drugs nor alcohol were detected by screening tests of the urine using Triage (Biosite Diagnostics, San Diego,

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