

CASE REPORT

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A case of fatal benzalkonium chloride poisoning

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Abstract Five elderly persons with senile dementia accidentally ingested Hoesmin, a 10% aqueous solution of benzalkonium chloride (BAC). The condition of one patient, an 84-year-old woman whose lips and oral cavity became erythematous, gradually deteriorated. Although gastric lavage was performed, the patient died 3 h after ingestion of Hoesmin. Autopsy revealed corrosive changes of the mucosal surfaces of the tongue, pharynx, larynx, esophagus and stomach which may have come in contact with BAC. In addition, BAC was detected in the serum.

We conclude that the patient died of BAC poisoning. Fatal BAC poisoning is rare and autopsy findings in only a few cases of BAC poisoning have been reported. Our findings emphasize the risk of oral ingestion of BAC.

Key words Benzalkonium chloride · Poisoning · Autopsy

Introduction

Benzalkonium chloride (BAC) is a cationic detergent that, like other quaternary ammonium compounds, is widely used as a germicide because the aqueous solution has low surface tension [1]. The toxic effects of quaternary ammonium germicides have been described in detail [1, 2], however, few reports of autopsy findings in cases of BAC poisoning have been published [3–5]. We describe a case of four patients with BAC poisoning and the autopsy findings of a patient who died of BAC poisoning.

Case report

Five elderly persons (four women aged 73, 82, 84 and 86 and a 91-year-old man) with senile dementia were resting in the dining room of a nursing home. One resident poured cups of 10% aqueous solutions of BAC (Hoesmin, Astra Japan, Osaka, Japan) for the others. After oral ingestion four persons suffered only from burning pains of the mouth and throat with sialorrhea. However, an 84-year-old woman whose lips and oral cavity became erythematous collapsed and vomited after having ingested what was believed to be less than 50 ml of Hoesmin. Although gastric lavage was performed immediately, the level of consciousness gradually decreased. On arrival at the hospital, the patient's condition had become critical and death occurred 3 h after ingestion of BAC.

Because the police suspected that the woman had not died of natural causes, an autopsy was performed 19 h after death.

Autopsy findings

The woman, 148 cm in height and 53 kg in weight, had been in good general health. The epithelium of the lips and palate were erythematous and easily removed. No other injuries were noted on the body surface except for a few subcutaneous injection marks. Corrosive changes were diffusely present on the mucosal surfaces of the tongue, pharynx, larynx, esophagus, and stomach which may have come in contact with BAC (Fig. 1). In particular, the stomach was completely devoid of mucosa and contained 10 ml of material, including abraded membrane. Although the brain, which weighed 965 g, displayed atrophic changes, no gross abnormalities were noted in another organs.

Microscopical findings

The portions of the digestive tract and adjacent structures which had been in direct contact with BAC showed marked erosion but not accompanied by inflammatory cell infiltration. The pathology changes, acute tubular necrosis in the kidney and central lobular necrosis in the liver, were compatible with acute circulatory failure. Other organs had no abnormal pathology changes except congestion.

Toxicological findings

Samples of serum, urine, and stomach contents were obtained at autopsy. Extraction and quantitative assay of BAC were performed according to the method of Suzuki et al. [6]. The analysis of BAC

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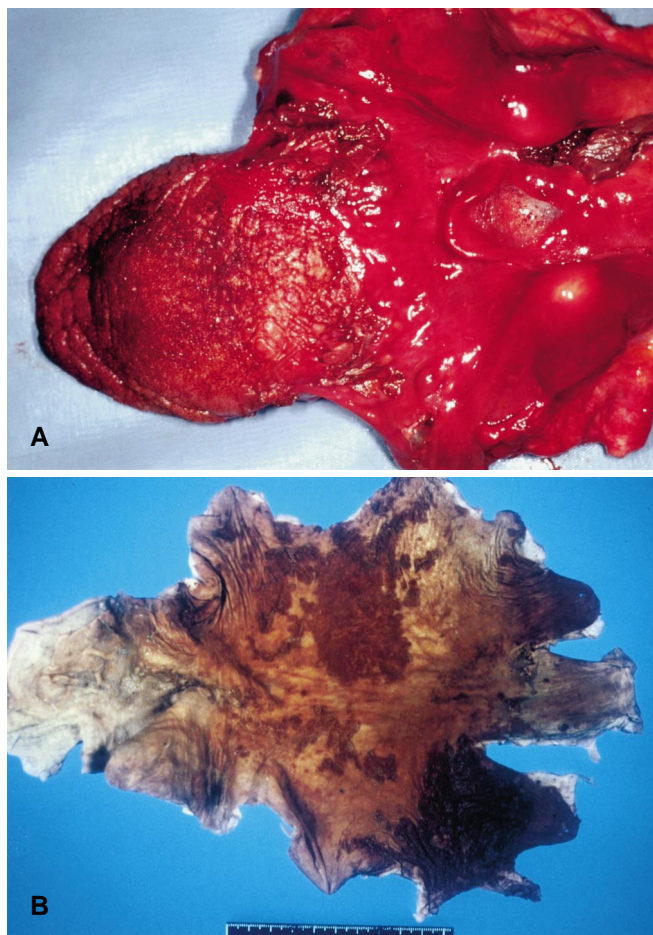


Fig. 1 The autopsy findings showing corrosive changes of the tongue, pharynx, larynx (A), and the stomach (B)

was performed with gas chromatography/mass spectrometry (JMS-DX 303, JEOL, Tokyo, Japan) and a 30 m × 0.32 mm i.d. fused silica capillary column (DB-1; film thickness, 0.1 mm; J & W Scientific, Folsom, CA, USA). The concentration of BAC in serum was 1.15 mg/ml. However, BAC was not detected in the urine or the stomach contents.

Discussion

Hoesmin, a 10% aqueous solution of BAC, is widely used clinically to disinfect the skin and mucosal surfaces. The toxicity of BAC can be divided into local effects, which are dependent on concentration, and systemic effects which are dependent on total dose [1, 4, 7]. Strong aqueous solutions (10–20%) of BAC commonly produce superficial necrosis of mucous membranes with which they come in contact. Systemic toxic effects depend on the dose absorbed through the mucosa and generally an oral dose of 100–400 mg/kg [5, 8] or a parenteral dose of 5–15 mg/kg [9, 10] is fatal in humans. In most cases of fatal ingestion, hypotension and other signs of circulatory shock are observed within a few minutes to 3 h [5, 8]. The few

published reports of autopsy findings in cases of BAC poisoning typically describe visceral congestion, erosion, ulceration, and corrosion of the upper alimentary tract [3–5]. However, the nature of toxic responses in humans varies widely with the dose and concentration of the product, the rate of administration and the survival time of the victim.

In the present case, the patient died after having ingested less than 50 ml of Hoesmin which contains 5 g of BAC. Therefore, the calculated ingested dose of BAC was less than 96.2 mg/kg, which is less than the previously reported fatal dose. Toxicological analysis revealed the presence of BAC in the blood, however because of emergency gastric lavage, BAC was not detected in the stomach contents. These findings indicate that BAC was absorbed into the blood from the alimentary tract within 3 h. Clinical symptoms of rapidly developing restlessness and the autopsy findings of corrosive change of the upper alimentary tract are compatible with those in previously reported cases of BAC poisoning. However, the pathology findings of epithelial sloughing without inflammatory infiltration were due to the short survival time.

In the present case, a nursing home resident died after ingesting a dose of BAC less than that previously reported as lethal. We assume that the potential for BAC poisoning is high as BAC is widely used as a germicide. Furthermore, persons who have senile dementia, as in the case reported, are at risk for ingestion of such toxic materials. Therefore, we suggest that medical and nursing staff in these facilities be especially vigilant to prevent residents from ingesting toxic materials.

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