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AN AUTOPSY CASE OF BUTANE GAS ABUSE

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Abstract

A case of fatal butane gas poisoning in a young female is presented. Quantitative toxicological analysis showed that the concentration of butane in the femoral blood was 6.8 μl/ml, and isobutane and propane were also identified. Severe congestion of the lungs and deposition of lipofuscin in the myocardium were also observed. We concluded that the cause of death of the victim was due to cardiac arrhythmia induced by the butane gas abuse.

Key words: butane – cardiac toxicity – poisoning

Souhrn

Pitevní nález při abúzu butanu

Je prezentován případ smrtelné otravy mladé ženy butanem. Kvantitativní toxikologickou analýzou byla stanovena koncentrace butanu 6,8 μl/ml v krvi z femorální žíly, dále byl detekován také isobutan a propan. Byl pozorován výrazný edém plicní a depozita lipofuscinu v myokardu. Stanovili jsme, že příčinou smrti oběti byla srdeční arytmie způsobená abúzem butanu.

Klíčová slova: butan – srdeční toxicita – otrava

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INTRODUCTION

The n-butane, a low molecular weight aliphatic hydrocarbon, is a colorless and flammable gas used commercially as a fuel source and/or a propellant [3]. It is usually mixed with n-propane and isobutane to produce a commercially available fuel [7]. In case of gas abuse, the cause of death may be due to asphyxia, vagal inhibition, respiratory depression or cardiac arrhythmia [2, 10]. Here we report a case of death caused by inhalation of a gas containing n-butane, with lipofuscin accumulation in the myocardium.

CASE HISTORY

A 23-year-old female (height 160 cm, weight 64 kg) suddenly collapsed after getting out of her friend's car, and was then transferred to the hospital. She was in cardiopulmonary arrest at the time of arrival at the hospital, and resuscitation attempts were unsuccessful. Three bottles of empty gas canisters were found near her seat during the subsequent investigation by the authorities. The main component of the gas was n-butane. She had a history of volatile gas abuse over the past few years. Her friend stated that she had been sprayed the gas directly into her throat in his car over the previous few hours.

Autopsy findings revealed that slight contusion of the forehead was observed as external injury. The heart weighed 285 g containing 200 ml of blood without coagula, and the brain weighed 1200 g, neither having any abnormal findings. The left and right lungs weighed 558 and 746 g, respectively, and were severely congested. The trachea was filled with a reddish frothy fluid. The stomach contained approximately 180 ml of foodstuffs. Histological examination revealed moderate fragmentation of the myocardium (Figure 1) and Schmorl's staining showed a large number of lipofuscin deposits around the nucleus of the myocardium (Figure 2). The lungs showed marked congestion and edema with alveolar hemorrhage (Figure 3).

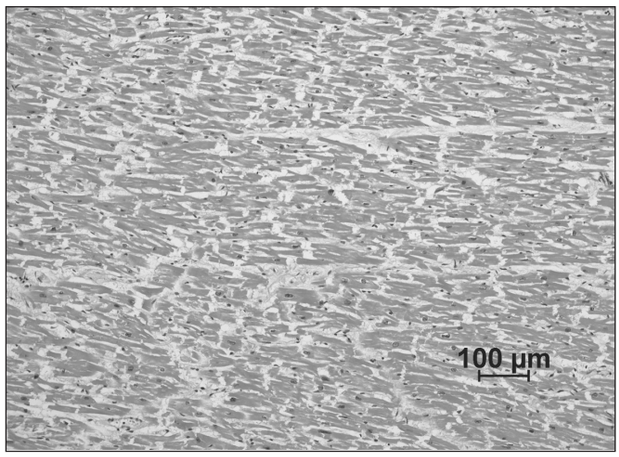


Figure 1. Fragmentation of the myocardium (HE staining, objects; x10)

Drug screening test using a Triage™ (Biosite Diagnostic Inc, San Diego, USA) panel was negative. No ethanol was detected by gas chromatography. Postmortem blood sample was collected in a sealed vial [14] for toxicological examination and kept at -70 °C until analysis. Toxicological analysis was performed using a gas chromatography-mass spectrometry, and the concentration of n-butane was determined by head-space gas chromatography, according to the method of Ago et al. [1].

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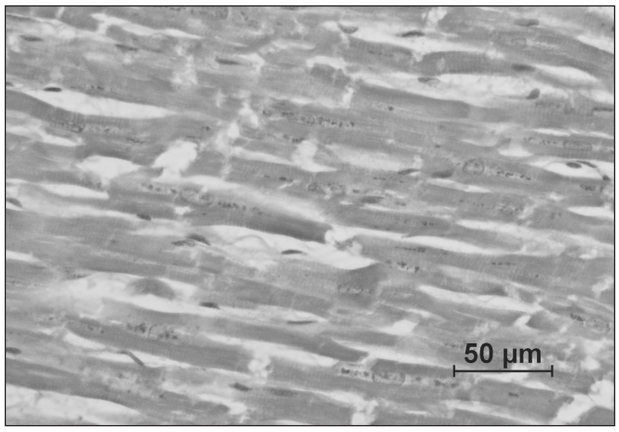


Figure 2. Lipofuscin deposition around the nucleus (myocardium, Schmorl's staining, objects; x40)

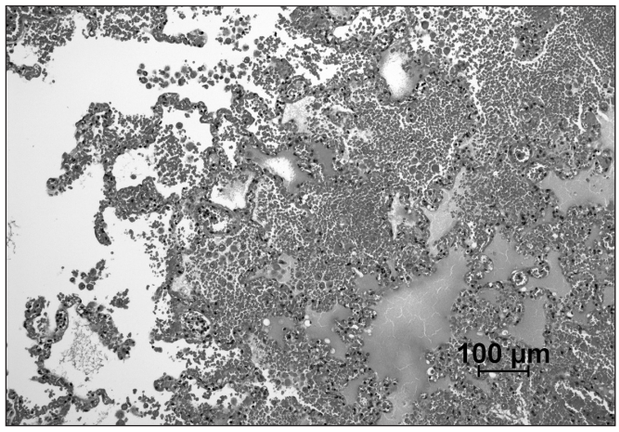


Figure 3. Marked congestion and edema with alveolar hemorrhage (lung, HE staining, objects; x10)

RESULTS AND DISCUSSION

The n-butane, isobutane and n-propane were identified by the toxicological examination. The concentration of butane in the victim's femoral blood was 6.8 µl/ml. This concentration was within the range of the previous reported fatal cases [1, 6, 8, 12]. In fatal cases of inhalation of gases contained n-butane, the most common cause of death is cardiac arrhythmia due to sensitization of the heart to adrenaline [9, 10]. From the autopsy findings, histological findings and the results of the toxicological examination, we concluded that the cause of death was cardiac arrhythmia due to butane gas abuse. Histological findings, such as the focal fragmentation of the myocardium and pulmonary edema with alveolar hemorrhage may support this conclusion. As she had not used plastic bag for inhalation, and there were no findings of aspiration of the vomitus in the present case, we speculate that acute asphyxia was less of a contributing factor to this fatality.

Histological study of the myocardium showed lipofuscin accumulation. There is no report of a relationship between the inhalation of butane and lipofuscin accumulation. Lipofuscin is a yellow-brown pigment composed of lipid and protein residues, which accumulates progressively in the normal aging process in postmitotic cells such as cardiomyocyte and neurons [4, 5, 11]. However, because the deceased was only in her twenties with no past histories, large numbers of lipofuscin pigmentation is not normal findings in the present case.

The formation of lipofuscin is also involved in oxidative stress and autophagy [4]. Oxidative macromolecular damage accumulates by normal mitochondrial respiration as an age-related change [13]. Autophagy is responsible for the lipofuscinogenesis in the heart [5], which is a cellular process responsible for the removal or recycling of long-lived protein and organelles via lysosomal degradation. We speculate that the increase of the lipofuscin accumulation in the heart may be the result of the impairment of autophagy in cardiomyocytes caused by butane abuse.

Autophagy is essential for cellular homeostasis in the heart, maintaining cardiac structure and function [5], and is involved in the pathophysiology of various kinds of diseases, such as cardiac hypertrophy, cardiomyopathies, ischemia and reperfusion [5,13]. Alterations of autophagy occur in various pathological conditions [13]. However, the function of autophagy is not completely understood, and it may have both protective and detrimental roles [5]. Butane abuse may be associated with autophagy by as yet unknown mechanisms. The impairment of autophagy may induce cardiac dysfunction. Further studies will be required to clarify these relationships. The present case indicates that we should pay more attention to cardiac toxicity in case of repeated use of volatile substances.

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