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A Case of Sudden Death due to Lighter Refill Gas Inhalation

Çakmak Gazı İnhalasyonuna Bağlı Ani Gelişen Ölüm Olgusu

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Abstract
A component of lighters refill tubes, butane is a colourless and flammable substance with gasoline-like or natural gas odour. The abuse of easily accessible lighter gas butane is increasing among children and adolescants and this abuse causes euphoric effects. Inhalants are the most commonly used drug after alcohol and tobacco among adolescents. In the literature, it is reported that butane inhalation directly affects central nervous system, respiratory and cardiovascular systems. To prevent this increasing trend, we believe that society, especially youth, should be educated through precautionary educational activities, sales of lighter refill tubes should be monitored and be made age-restricted, and lighter refill tubes should have warning signs that everyone would understand and attract attention. We present a case of the sudden death of a seventeen-year-old male due to inhaling butane containing lighter refill gas with friends along with the autopsy findings and the results of toxicology and histopathology investigations.
Keywords: Butane; Lighter Refill Gas; Sudden Death; Autopsy.

Öz
Renksiz, yanıcı özellikte ve doğal gaza benzer kokusu bulunan bütan gazı çakmak dolumunda kullanılan gazın bileşimde bulunmaktadır. Kolay ulaşılması nedeniyle çakmak gazı solunması çocuklarda ve gençlerde giderek yaygınlaşan keyif verici amaç için kullanılmaktadır. Adölesanlarda sigara ve alkolden sonra en sık kötüye kullanılan madde olduğu belirtilmektedir. Literatürde bütan gazı inhalasyonu sonrası santral sinir sistemi, solunum ve kardiyovasküler sistemin etkilendiği olgular bildirilmektedir. Bu artış eğilimini önlemek için, toplum, özellikle gençlerin, eğitim etkinlikleri yoluyla eğitilmeleri gerektiğine inanıyoruz. Ayrıca çakmak dolum tüpü satışları izlenmeli ve yaş kısıtlaması yapılmalı, hafif dolum tüplerinin üzerine herkesin anlayacağı ve dikkatini çekeceği uyarı işaretleri konulmasının yararlı olacağı kanaatindeyiz. Çalışmada; iki arkadaşıyla birlikte bütan içerikli çakmak gazı solunması sonrası ani ölüm meydana gelen 16 yaşındaki erkek olgu otopsi bulguları, toksikolojik ve histopatolojik inceleme sonuçları ile sunulmaktadır.
Anahtar Kelimeler: Bütan; Çakmak Gazı; Ani Ölüm; Otopsi.

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INTRODUCTION

Substance abuse is a major public health problem affecting the health of individuals and society. It is also the cause of serious burden to economy through loss of labor force, increase in illegal actions, and health problems. Research has shown that substance use is increasing all over the world and that it especially affects young population (1).

According to the 2012 data of the United Nations Office on Drugs and Crime (UNODC), 5% of the world population aged 15-64 use illicit drugs. UNODC's research in six cities in Turkey conducted among participants aged 15-64 has shown that cannabis use (by 4.3%) and inhalant use (by 4.2%) are the most common drugs abused "at least once in a lifetime" (2-3).

Volatile substance use is the most commonly abused substance after alcohol and cigarettes because they are easy to reach and use as they are also cheap showing rapid effect; they are also commonly used in group activities as a source of joy as an alternative to alcohol (1, 4). Inhalant use is most commonly observed in 13-15 years of age while it peaks between the ages of 11 and 17 (4). In Turkey, the most commonly abused volatile substances are toluene (paint thinner), chlorinated hydrocarbons, and lighter refill gas (5). The contents of lighter refill gas generally include a high proportion of butane in aliphatic hydrocarbon structure and a small portion of isobutane and propane (1, 6).

Butane, CH3(CH2)2CH3 (also known as n-butane, butyl hydride, or methylethyl-methane), is a colourless, flammable gas with a smell similar to that of natural gas (7, 8). Following its intake, it creates a euphoric effect, disinhibition, visual and auditory hallucinations along with flying or floating sensation (1, 9). Because it is applied by spraying the lighter refill gas directly into the mouth, it is difficult to set the dose, which in turn can lead to sudden cardiac death (1, 9). Butane replaces oxygen and creates asphyxiating effects that leads to unconscious dangerous behaviour and eventually to traumas, vagal inhibition, respiratory depression, and sudden sniffing death syndrome (8, 10). Caused by ventricular arrhythmia due to large amount of catecholamine release, sudden sniffing death syndrome accounts for 50% of volatile substance related deaths (8).

In this study, we present the autopsy findings of a 16-year-old male, who died due to sudden sniffing death syndrome after inhaling butane from a lighter refill can with two of his friends, discuss the results of toxicological and histopathological examination in the light of the literature, and draw attention to the increasing prevalence of the problem of use of volatile substances and the risk of sudden death.

CASE REPORT

It is related that a 16-year-old male patient suddenly collapsed during gas inhalation from the butane containing lighter refill tube with two friends upon which his friends had called 112 emergency services. He was taken to hospital by the emergency service staff but was lost in the hospital despite all interventions. Crime scene investigation carried out by police officers confirms the abuse of butane containing lighter refill tubes which were also used by his two friends. We were unable to reach the patient's medical file about the incident.

The autopsy conducted 5 hours after the death of the person revealed that he was 185 cm tall, weighed 70-75 kg, and had a tattoo on his left forearm that read "Good Day To Die..♡" (Figure 1). The patient had two circular-shaped panther figures on the left arm, bloody fluid coming out through the nostrils, ecchymosed graze areas around the left scapula and left lumbar region, defibrillator spoon scars, and pin traces on the inside of both elbows and on the left wrist.

Figure 1. The tattoo on the arm of the lost patient.

When the headroom was opened up, we discovered petechiae areas under the scalp; there were oedema and hyperaemia in the brain, cerebellum, and the brain stem (Figure 2). The brain weight was 1434 grams. The chest examination showed broken ribs on the midclavicular line on the 1st-3rd ribs due to revitalisation process, sub-epicardial petechial bleeding areas in the heart, and hyperaemia around the myocardial areas. Both lungs were swollen with bright oedemas and petechial haemorrhage. The right lung weighed 846 grams while the left lung was about 1050 grams. The sections of the lungs had congestion and the bronchi and bronchioles showed signs of bloody foamy liquid (Figure 3). The stomach contained 100ml of dark brown-black liquid. The liver and right kidney revealed areas with hyperaemia.

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Figure 2. Oedematous view of the brain with hyperaemia.

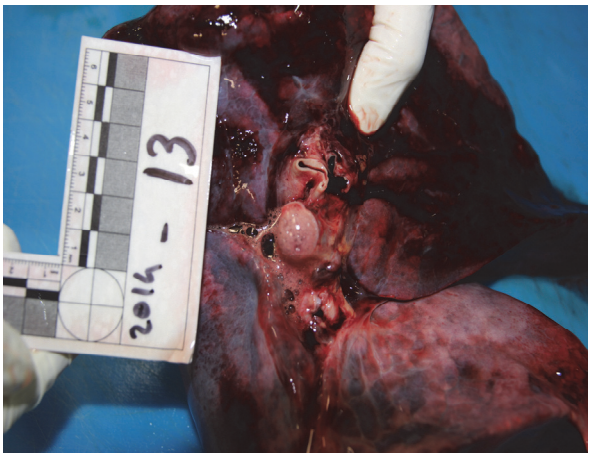

Figure 3. The swollen view of the lungs with oedemas

The samples obtained from the heart, brain, kidney, liver, lungs, and pancreas were sent to the pathology laboratory in 10% formaldehydes for histopathological evaluation. The tissue samples were stained with hematoxylin-eosin (HE) and evaluated with a light microscope following routine tests. The microscopic examination showed oedema and fresh intra-alveolar haemorrhage in the lung, autolysis in the pancreas, and extravasated red blood cells in the parenchymal fat tissues. The examination of other body samples showed signs of congestion.

We collected samples from the liver, kidney, stomach contents, brain and fat tissue, intraocular fluid, bile, and blood as well as the entire right lung obtained from the right bronchial side in a closed environment, nasal swabs, and nasopharyngeal swab and sent these samples to the chemistry lab at Institute of Forensic Medicine, Malatya Headquarters where the autopsy was carried out for systematic toxicological evaluation. The samples were maintained in the refrigerators of the chemistry lab in accordance with the procedures until necessary investigations were carrie out. Studying the samples with Gas Chromatography Mass Spectrometry (GC/MS) device, we found butane, one of the lighter refill gas components, in the blood samples and lung samples with blood. We did not observe alcohol or other toxic substances in the analysis of the samples. According to the autopsy findings and histopathological results of the samples, we did not find any evidence of natural disease or a trauma that could have caused his death. We assumed that the death of the person was due to the toxic effect and respiratory complications caused by directly inhaling lighter refill gas (butane).

DISCUSSION

With its low molecular weight, lipophilic nature, and aliphatic hydrocarbon structure, butane creates sedative effects in the central nervous system by taking the place of oxygen and leads to death through asphyxiating effects. It is stated that majority of the deaths caused by butane inhalation are due to direct toxic effect, aspiration, asphyxia, and cardiac arrhythmia (11). There are studies on the concentration of butane affecting the brain, spleen, kidney, adipose tissues, lung, and blood distribution. Especially in the cadavers that are in the decomposing process, butane is at detectable levels when its concentration is reduced in adipose tissues (10). Butane is known to boil at -0.5 degree C in room temperature and under normal atmospheric pressure. If blood samples are kept at room temperature or at 40 degrees C, gas concentration tends to decrease. Studies have shown that butane gas concentration is reduced by 10% within 2 weeks if samples are stored at -300 degrees C (11). Therefore, if an examination is not going to be conducted soon, samples are recommended to be stored at -300 degrees C.

Direct toxic effect (51%), asphyxia caused by use of plastic bags (21%), gastric content aspiration (18%), and traumatic (drowning, traffic accidents, hanging etc.) reasons are among the common causes of volatile component inhalation related deaths (12).

Because our patient died in the hospital during cardiopulmonary resuscitation, the reason of death has been evaluated in the light of the autopsy and scene investigation findings. The autopsy has reported pulmonary oedema, bloody frothy fluid in the bronchi and bronchioles, cerebral oedema, and congestion and petechial haemorrhages in the internal organs. Blood samples and lung samples of blood showed signs of butane, one of the lighter gas components. These findings are consistent with asphyxiating changes associated with butane inhalation in the literature. It is indicated that pathognomonic morphological changes have not yet been identified in deaths caused by butane inhalation (8). Therefore, a detailed crime scene investigation of the materials that would confirm inhalation of volatile gases along with swiftly conducted toxicological examination of cadavers will help achieve conclusive diagnosis. At length, in the light of the autopsy findings and results of toxicological and histopathological examinations, we believe that the death of the person was caused by asphyxia due to butane-induced direct toxic effect and respiratory depression.

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CONCLUSION

The low prices and accessibility of volatile substances that lead to addiction by sniffing or inhaling and negatively affect the physical and psychological development of younger population increase the abuse of these substances by children and young people. To prevent this increasing trend, we believe that society, especially youth, should be educated through precautionary educational activities, sales of lighter refill tubes should be monitored and be made age-restricted, and lighter refill tubes should have warning signs that everyone would understand and attract attention. Besides, addition of malodorous substances into lighter refill tubes will also be beneficial in reducing their abuse.

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