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# Crime Scene and Autopsy Findings in two Cases of Sudden Death Caused by Inhalation of Butane Gas

## Bütan Gazı Solunması Sonucu Meydana Gelen İki Ani Ölüm Olgusunda Olay Yeri ve Otopsi Bulguları

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### Abstract

Solvent inhalation is still an important public health problem that is responsible morbidity and mortality of young people worldwide and has adverse effects on society. In Turkey, solvent inhalation is the most common substance abuse following smoking and alcohol addiction, and butane and propane have been reported to be the most frequently inhaled substances. In this study, the crime scene information is presented, with the pathology and toxicology analysis results of two cases of death due to inhalation of n-butane, one as suicide and the other accidentally. Although clinical findings were described in detail in cases hospitalized due to butane gas inhalation and in death cases, the number of articles describing crime scene and autopsy findings is limited. In this case report, it is aimed to describe of the findings that they may encounter during the crime scene and death examination, especially for general practitioners and autopsy findings of cases. Consequently, it is important for the general practitioners participating in the corpse examination to be careful about the crime scene and the findings on the corpse, for accurate toxicological analyzes and accurate determination of the cause of death. These physicians should give clues to forensic experts about signs such as thinner, glue, or gas source near the corpse, a plastic bag placed on the head of the corpse, vomit stains near the corpse or on their clothing.

**Keywords:** Butane; inhalation, solvents; substance abuse; autopsy.

### Özet

Solvent inhalasyonu halen dünya çapında gençlerin morbidite ve mortalitesinden sorumlu olan ve toplum üzerinde olumsuz etkileri bulunan önemli bir halk sağlığı sorunudur. Türkiye'de solvent inhalasyonu, sigara ve alkol bağımlılığından sonra en sık görülen madde kötüye kullanımı olup, bütan ve propanın en sık solunan maddeler olduğu bildirilmiştir. Bu çalışmada, biri intihar, diğeri kaza ile n-bütan solunması sonucu meydana gelmiş iki ölüm vakasının patoloji ve toksikolojik analiz sonuçları ile olay yeri bilgileri sunulmaktadır. Literatürde, bütan gazı solunmasına bağlı olarak hastaneye kaldırılan olgularda ve ölüm olgularında klinik bulgular ayrıntılı olarak tanımlanmış ise de, olay yeri ve otopsi bulgularını tanımlayan makale sayısı sınırlıdır. Bu olgu sunumunda, özellikle olay yeri ve ölü muayenesinde pratisyen hekimlerin karşılaşılabilecekleri bulguların ve otopsi bulgularının tanımlanması amaçlanmıştır. Sonuç olarak, ceset muayenesine katılan pratisyen hekimlerin doğru toksikolojik analizler ve ölüm sebebinin doğru tespit edilebilmesi için, olay yeri ve ceset üzerindeki bulgular konusunda dikkatli olmaları önemlidir. Bu hekimlerin, cesede yakın yerde bulunan tiner, yapıştırıcı veya gaz kaynağı, cesedin başına geçirilmiş naylon torba, cesedin yakınında veya giysilerinde bulunan kusmuk lekeleri gibi bulguların varlığı veya yokluğu konusunda adli tıp uzmanlarına ipuçları vermeleri gerekmektedir.

**Anahtar Kelimeler:** Bütan; inhalasyon; solvent; madde kötüye kullanımı; otopsi.

### Introduction

First documented during the First World War, solvent inhalation gradually became substance abuse in western countries from the first quarter of the 1900s (1). It is still an important public health problem that is responsible for morbidity and mortality of young people worldwide and has adverse effects on society (2-5). Although halogenated hydrocarbons, which used to be propellants in aerosol cans until 1978 and were

frequently abused, were replaced by aliphatic hydrocarbons due to the damage they cause to the ozone layer, substance abuse has not been able to be prevented (6). Deaths due to solvent inhalation may occur with accidental exposure of workers in sectors such as petrochemicals, plastics industry, furniture production, and printing (7), accidental exposure during autoerotic acts (8), and suicides (3,6,8). These deaths are most commonly associated with substance abuse. In Turkey,

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solvent inhalation has been defined as the most common substance abuse after smoking and alcohol addiction (4), and butane and propane have been reported to be the most frequently inhaled substances (9). While inhaling butane, sudden death may occur due to suffocation, trauma, vagal inhibition, respiratory depression, cardiac arrhythmia, or Sudden Sniffing Death Syndrome (1,2,4,10). Likewise, deaths from burns and explosions can be seen during the inhalation of gas from lighter gas refills and gas cylinders (5). Although autopsy is performed, the process of investigating the cause and origin of death is quite complex following volatile substance inhalation (2). Although clinical findings have been described in detail in cases hospitalized due to butane gas inhalation and in death cases, the number of articles describing crime scene and autopsy findings is limited. The aim of this study was to present the crime scene information and death examination findings for general practitioners, who are the first to encounter death in Turkey, and to describe the autopsy findings together with pathological and toxicological analysis results.

## Cases

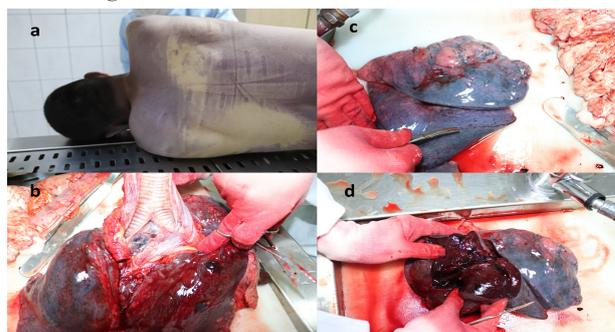
**Case 1:** A 29-year-old male professional soldier was found dead on the sofa in his room on the top floor of a building used as a 4-storey dormitory. In the crime scene investigation accompanied with forensic medicine specialist, a kitchen gas cylinder was found 2.5 meters away from the corpse, with one end of the hose connected to the cylinder and the other end free in the room (Figure-1).



**Figure 1.** The room where the first case was found dead: a) a kitchen gas cylinder and hose with one end connected to the gas cylinder, b) general view of the room, c) corpse

In the crime scene investigation, nothing else remarkable was found in the room, and it was determined that the doors and windows were locked from the inside. In the anamnesis taken from relatives, it was learned that the deceased had previously expressed suicidal thoughts and had no history of volatile substance abuse. In the examination of the corpse, cyanosis was observed

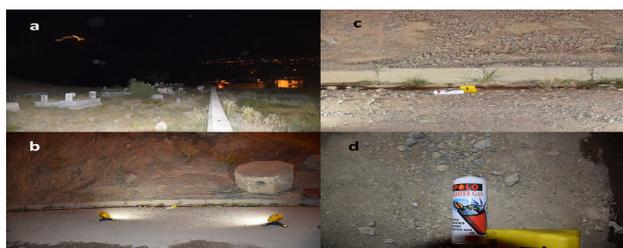
on the lips, auricles and nail beds, and livor mortis was demonstrated in the dark purple color. No other traumatic findings were observed on the body. Closed blood samples and samples from the lungs were taken at autopsy, subpleural petechiae were observed in the macroscopy of the organs, the lungs were swollen and edematous, lung sections were edematous and bleeding (Figure-2), and no other macroscopic features were found in other organs.



**Figure 2.** In the first case; a) dark purple colored livor mortis b-c) subpleural petechiae and swollen and edematous lungs, d) edematous and bleeding lung sections.

In the histopathological examination, edema, intra-alveolar hemorrhage, intra-alveolar pigment-loaded histiocytes and congestion were observed in the lungs, and no microscopic pathology was detected in other organs. In the toxicology analyses by HS/GC/MS, “butane” was detected in blood and lung samples. It was concluded that the cause of death was suffocation complications due to inhalation of volatile lighter gas (butane).

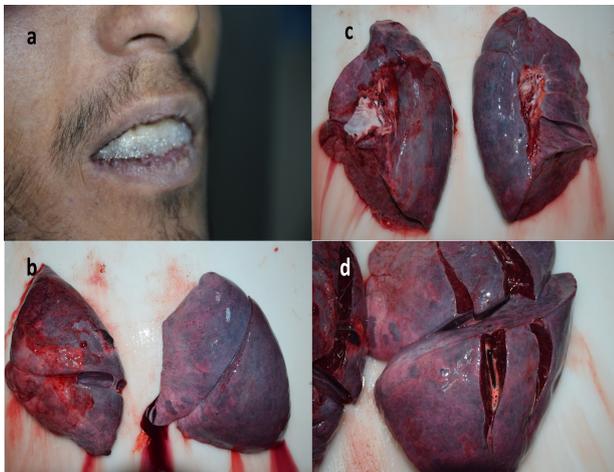
**Case 2:** An 18-year-old male was found by his family on waste ground next to the cemetery just behind his house, in an aggressive and agitated state. He was taken to the nearest state hospital emergency room by the 112 team. Medical interventions were inadequate and the patient died. In the crime scene investigation accompanied with forensic medicine specialist, an empty lighter gas container on which the victim’s fingerprints were determined was found in the cemetery where he had been found (Figure-3).



**Figure 3.** a-d) Area where the second case was found in an agitated and aggressive state and an empty lighter fluid container



**Figure 4.** In the second case; a) light purple colored livor mortis b-d) tattoos and old incision marks on various parts of the body



**Figure 5.** In the second case; a) foam around the mouth, b-c) subpleural petechiae and swollen and edematous lungs, d) edematous and bleeding lung sections.

In the history taken from the family, it was learned that the deceased had a history of volatile substance abuse. In the detailed examination of the corpse, foam coming from the mouth was observed. Tattoos were seen on various parts of the body, and old parallel incision marks were seen on the chest, front, arms and other parts of the body. Livor mortis was present as a light purple color (Figure-4). No other traumatic findings were observed on body. Closed blood samples and samples from the lungs were taken at autopsy, subpleural petechiae were observed in the macroscopy of the organs, the lungs were swollen and edematous, lung sections were edematous and bleeding (Figure-5), and no other macroscopic features were found in other organs. In the histopathological examination, edema, intra-alveolar hemorrhage, intra-alveolar pigment-loaded histiocytes and congestion were observed

in the lungs, and no microscopic pathology was detected in other organs. In the toxicology analyses by HS/GC/MS, “butane” was detected in blood and lung samples. It was concluded that the cause of death was suffocation complications due to inhalation of volatile lighter gas (butane).

## Discussion

First reported by Sir Edward Frankland (1825-1899) in 1849, butane, or n-butane, is an alkane with the formula  $C_4H_{10}$ , which is gaseous at room temperature and atmospheric pressure in sea level, highly flammable, colorless, easily liquefied and quickly vaporizes at room temperature (3,5). Symptoms in acute butane inhalation and chronic butane exposure defined in the literature were presented in Table-1 (5,9,11). Lighter gas is frequently used for volatile substance abuse, especially by young people, due to its low cost, ease of access and that it is included in household products (3). The age of onset of volatile gas inhalation has been said to be between the ages of 9-15 years, is most common between the ages of 15-20 years, and almost all cases are male in Turkey (2,3,10). While suicidal deaths due to butane inhalation are more common in inhalant abusers, they are less common in the general population (5). Gurses et al. reported 5 suicide cases aged 25-62 years, 2 of which were inhaled from kitchen gas cylinders and 3 from a natural gas pipe (3). Durao et al. described an unusual suicide case of butane gas inhalation through a homemade adaptation of a continuous positive airway pressure face mask (11). The first case in the current study was a 29-year-old male, and the prosecution investigation concluded that he committed suicide by filling the room with gas or lying down after inhaling the gas. Considering that the first of the two cases presented in this paper was found dead at the scene and the other died shortly after hospital admission, it was thought that both cases were exposed to intense butane for a short time. Sironi stated that the evaluation of the cause and mechanism of death in butane inhalations is mainly based upon scene investigation data or histological and toxicological analyses since specific findings cannot be reached at autopsy as with most asphyxia deaths (6). In cases of such abuse-related deaths, the detection of thinner, glue cans or gas source close to the corpse at the crime scene, the presence of the corpse with a nylon bag attached to the head, and vomit stains on near of corpse or on the his/her clothes were defined as valuable findings (2,3).

**Table 1:** Symptoms in Acute Butane Inhalation and Chronic Butane Exposure (5,9,11).

Symptoms in Acute Butane Inhalation	Symptoms in Chronic Butane Exposure
Irritability	Dysrhythmias
Cough	Myocardial Fibrosis
Euphoria	Direct Myocardial Toxicity
Excitation	Myopericarditis
Nausea	Ataxia
Headache	Loss Of Motor Control
Rhinorrhea	Peripheral Neuropathy
Sneezing	Encephalopathy
Vomiting	Optic Atrophy
Syncope	Tremor
Abnormal Speech	Sensorineural Hearing Loss
Confusion	Dementia
Delusions	Depression
Decreased Reflex	Insomnia
Anoxia, Hypoxia, and Asphyxia	Memory Loss
Tachycardia	Psychosis
Hallucinations of All Senses	Anemia
Ataxia	Thrombocytopenia
Dissociation	Leukopenia
Tinnitus	Cough
Nystagmus	Emphysema
Dizziness	Chemical Pneumonitis
Fatal Arrhythmia	Hematuria
Ventricular Fibrillation	Proteinuria
Cardiac Arrest	Renal Tubular Acidosis
Depression of Central Nervous System	Acid-Base Disturbance
Sudden Death	Renal Failure

In the autopsies of both cases in the current study, there was no specific feature other than non-specific asphyxia findings such as subpleuralpetechial hemorrhages, edema in the lungs and hemorrhagic appearance in the lung sections. In the examination of the second case, numerous tattoos and old incision marks were found on the body. Similar pulmonary findings and non-specific asphyxia findings have been reported in previous autopsy studies (2,4,11). In a study by Cetin et al., tattoos and old incision scars were reported to be closely related to sociopathy and substance abuse (12). In previous studies, it was stated that autopsy should be performed in the early period in cases of death due to inhalation of volatile substances. In addition, it has been suggested that the sample taken from the inhaled lungs at autopsy should be transported to the laboratory in a closed plastic container without being exposed to the outdoor (2,3). Likewise, this procedure was applied for the cases in current study. Novosel et al., described diffuse intra-alveolar hemorrhagic edema with activation of macrophages and erythrophagia, colorless “blebs” located in the intra-alveolar septal walls,

vesicularization, and total anemia caused by intense microcirculation obstruction in the histopathological examination of the lungs of two cases who died as a result of butane inhalation (1). In the current cases, edema, intra-alveolar hemorrhage, intra-alveolar pigment-loaded histiocytes and congestion were observed in the lungs of both, and butane was detected in the lungs and blood of both cases. As a result, general practitioners participating in the corpse examination should be careful about the above-mentioned crime scene and the findings on the corpse in order to determine the cause of death correctly and offer clues to the forensic medicine specialists to direct toxicological analyses.

**Ethical approval:** This study was carried out with the permission of the Non-Interventional Clinical Research Ethics Committee of Van Yuzuncu Yil University Faculty of Medicine (decision number: 2021/12-09, dated: 24.12.2021)

**Conflict of interest:** The authors declare that this article sent for publication in your journal is original, the scientific and ethical responsibility belongs to us and there is no conflict of interests.

**Financial support:** We declare that this study has not received any financial support and there are no financial conflicts.

**Author contributions:** We declare that all the authors whose names are written contributed during the preparation of the study for publication and that the authors approved by reading the final version of the publication.

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