



Critically Affected Children Owing to Butane Abuse in Pediatric Intensive Care: Clinical Courses and Outcomes

Çocuk Yoğun Bakımda Bütan Kötüye Kullanımı Nedeniyle Kritik Etkilenen Çocuklar: Klinik Seyirleri ve Sonuçlar

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Abstract

One of the most common health problems today is volatile substance abuse and toxic gas inhalation. Butane gas, also known as lighter gas, is increasingly used because it causes euphoria, pleasure and joy among adolescents. The most important reasons for this situation are the fact that it is cheap and easy to obtain, and at the same time the legal audit is not very serious. In this article, two adolescent male patients who were followed up in our pediatric intensive care unit after lighter gas inhalation are presented. The first case was discharged, and the second case died despite extracorporeal cardiopulmonary resuscitation due to cardiac arrest during admission to our hospital from another center. In our study, it was aimed to draw attention to the fact that butane gas inhalation, which has been increasingly common in childhood, is responsible for significant morbidity and mortality.

Keywords: Butane gase, lighter gas, pediatric intensive care

Öz

Günümüzde sık karşılaşılan sağlık sorunlarından biri uçucu madde kullanımı ve toksik gaz inhalasyonudur. Çakmak gazı olarak da bilinen bütan gazının ergenler arasında öfori, keyif ve neşe oluşturması nedeni ile kullanımı giderek artmaktadır. Bu durumun en önemli nedenleri ucuz ve temininin kolay olması ile beraber aynı zamanda yasal denetimin çok ciddi olmamasıdır. Bu yazıda çakmak gazı inhalasyonu sonrası çocuk yoğun bakım ünitemizde takip edilen iki olgu sunulmuştur. Birinci olgunun taburculuğu yapılmış, ikinci olgu ise başka bir merkezden hastanemize kabulü sırasında kardiyak arrest olmasına yönelik ekstrakorporeal kardiyokciğer resüsitasyon uygulanmasına rağmen kaybedilmiştir. Çalışmamızda çocukluk çağında son zamanlarda giderek yaygınlığı artan bütan gazı inhalasyonunun önemli ölçüde morbidite ve mortaliteden sorumlu olduğuna dikkat çekilmesi amaçlanmıştır.

Anahtar Kelimeler: Butan gazı, çakmak gazı, çocuk yoğun bakım

Introduction

The use of volatile substances and toxic gas inhalation is a significant social problem in Turkey, as it is in many countries. Inhalant use is most common among 7-19-year olds and prevalent among the male population.¹ Adolescents usually inhale gas for curiosity or to experience feelings of euphoria. In addition, butane gas is the most preferred choice, which is cheaper and easier to obtain. Lighter gas is associated with the highest mortality rate among abused substances.² Depending on the method and duration of use, mild

symptoms such as dizziness, nausea, vomiting, euphoria and hallucination can be observed, whereas reasons such as suffocation, vagal inhibition, respiratory depression, trauma and cardiac arrhythmia might result in sudden death.³ Here, we present the clinical follow-up and results of two adolescent male cases who were admitted to our paediatric intensive care unit (PICU) due to it's the critical impact from butane gas inhalation. In our study we draw attention to the fact that butane gas inhalation, which is increasing in use among youths and adolescents, is responsible for significant morbidity and mortality.

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Case Reports

Case 1

A 16-year-old male patient, who was previously healthy, was taken to hospital four hours after inhaling lighter gas with complaints of recurrent vomiting, stagnation, and general disturbance in his general condition. On admission to the hospital, the patient, whose general condition was poor and who was unconscious. He was intubated and an adrenaline infusion was started due to circulatory disorder. The patient, who was started with insulin and whose inotropic support was given as adrenaline, noradrenaline, dopamine and hydrocortisone, was admitted to the PICU because of the possibility of needing extracorporeal membrane oxygenation (ECMO).

On physical examination, the patient's overall condition was poor. He was intubated with oxygen saturation 98%, body temperature was 36.5 °C, heart rate was 96/min, and his blood pressure was 106/54 mmHg. The patient received adrenaline, noradrenaline, dopamine and hydrocortisone as inotrope support; in addition, he received insulin infusion due to high blood sugar, and bicarbonate was given because metabolic acidosis was found in his laboratory examinations. By starting hypertonic saline infusion to avoid the risk of cerebral edema no pathology was detected except subgaleal edema in the occipitoparietal region measuring 2.5 cm in its thickest part in the taken brain CT. In the first admission, the creatinine value increased to 3.2 mg/dL, the control creatinine value increased to 4.2 mg/dL after four hours, and the urine output was less than 0.5 cc/kg/hour. Despite the treatments, the patient was placed on a central venous catheter and continuous veno venous hemodialysis (CVVHD) was started. Pain localization was better on the second day of follow-up. Due to its normotensive and neuroglycemic course, dopamine, hydrocortisone and insulin infusions were discontinued and adrenaline and noradrenaline doses were reduced. Since the patient whose CVVHD was stopped on the third day of his admission, due to the spontaneous urine output, furosemide infusion was started. When compared with the previous examination, it was observed that the subgaleal edema in the occipitoparietal region increased by 3.5 cm in the thickest part of the control brain computed tomography. Neurosurgery said that there is no need for any invasive intervention. On the fourth day of hospitalization the patient regained normal sinus rhythm after the application of cardioversion, due to the presence of pulsating ventricular tachycardia (VT), prophylactic amiodarone infusion was started, and due to oliguria CVVHD was restarted. On the fifth day of his hospitalization, for the purpose of evaluating

his state of consciousness, sedation was stopped. We could see his fluctuating consciousness and after that eye blinking and extremity movements due to our commands. Although there were widespread encephalopathic findings in electroencephalography, no epileptic activity was detected. Due to high blood pressure, the inotropic supplements he was taking were gradually stopped. The patient, whose consciousness was better on the sixth day of the follow-up, was continued on dialysis due to the absence of urine, although haemodialysis was intermittently stopped. Extubation was performed on the seventh day. Dialysis was interrupted when the diuretic infusion was initiated on the ninth day of his follow-up and his haemodialysis was stopped on the ninth day of his follow-up. He was transferred to the paediatric nephrology service on the tenth day of his admission. During the follow-up, he was fully conscious and his kidney functions improved. The patient is now clinically normal.

Case 2

A 15-year-old male patient, two days before his admission to our hospital, was brought to the emergency department after being informed to the 112-emergency team, due to the development of confusion after inhalation of lighter gas with his friends in another city. As the patient's heart rhythm was in pulseless VT, the patient received cardiopulmonary resuscitation (CPR) and defibrillation for up to 5 minutes, subsequently the patient's heart rate returned to normal. The patient was intubated and hospitalized in the PICU. Dopamine infusion was initiated in the hypotensive patient and the ejection fraction was measured as 18 in echocardiography. In laboratory tests, cardiac enzymes were found to be too high to be measured. The patient was given triple inotrope (dopamine, dobutamine and milrinone) support due to resistant hypotension, and adenosine was administered due to the development of supra VT, and then amiodarone infusion was initiated. After two days of follow-up, the patient, whose heart functions did not change despite receiving high doses of inotrope support, was admitted to our hospital due to the need for ECMO. The patient was transported from a hospital located in another city by air-ambulance. We started CPR due to the development of cardiac arrest (CA) in the emergency room, and after 10 minutes of CPR, we decided on extracorporeal cardiopulmonary resuscitation (ECPR). The patient who was admitted to the PICU with was performing CPR. ECMO was installed on the left femoral artery and vein as VA ECMO in 115th minutes of CPR. However, since the heart rhythm of the patient did not return under ECMO, he was pronounced dead. The demographic, clinical characteristics, treatments and results of both patients are given in Table 1.

Table 1. Patients' demographic, clinical features, interventions and outcomes

Parameters	Cases	
	1	2
Gender	Male	Male
Age (years)	16	15
History of cardiac arrest	No	Yes
Length of PICU stay* (days)	10	1
Length of hospital stay (days)	31	1
Mechanical ventilation time (days)	7	1
CRRT [†]	Yes	No
ECMO [^]	No	Yes
Mortality	No	Yes
Sequel	No	-

*PICU: Pediatric intensive care unit, [†]CRRT: Continues renal replacement therapy, [^]ECMO: Extracorporeal membrane oxygenation

Discussion

The fact that volatile substances are the ones used in our daily life, that they constitute a step toward the use of heavier substances, and the early onset of abuse are social problems all over the world, but also an important health problem in adolescents and young adults. The frequency of inhalant use varies in societies. In a study conducted in Australia among students aged 12-17, it was reported that 27.3% of adolescents inhaled lighter gas at least once in their life.⁴ Although the abuse of butane gas is seen in different age groups, it is more common in children between the ages of 7-19 and male (1,2). In the article in which 282 deaths related to inhalant use were reported in the United Kingdom, it was shown that 95% of the participants were male.⁵ Our cases were also in line with the studies conducted on this subject, either in terms of age or gender.

Although the mechanism of sudden death due to inhalant use is not fully known, different mechanisms have been reported for the emergence of "sudden sniffing death syndrome". "Sudden sniffing death syndrome", first described by Bass in the literature, is responsible for 55% of deaths caused by the abuse of volatile substances.⁶ Studies have reported that butane gas increases the sensitization of the myocardium to the arrhythmogenic effects of endogenous catecholamines. The increase in sympathetic activity in users, whether due to hallucination due to the effect of toxic gas, running from the scene after inhalation to conceal substance use, and other reasons, increases the secretion of endogenous catecholamines. It is thought that these rapid fluctuations in adrenaline level may cause severe vasospasm, arrhythmia and sudden death.^{3,7}

One of the conditions that need to be considered due to lighter gas inhalation is the administration of antiarrhythmic drugs such as amiodarone or beta blockers because of reducing the risk of recurrent ventricular fibrillation together with classical adrenaline applications in CPR applied to these patients.^{8,9} In our study, pulsed VT was detected in the first case and pulseless VT was detected in the follow-up of the second. In the first case, amiodarone infusion was started after cardioversion, and in the second case only defibrillation was applied.

Although patients have serious systemic side effects, especially cardiac, and fatal complications, it is seen in case one that patients can return to their normal life if they survive this process. In both cases, it is observed that cardiac involvement is the basis of the events that cause life-threatening patients. The main reasons for the death in case two, are the occurring of cardiac arrest before entering the emergency room, the absence of a response to CPR, the possibility of ECPR being set up at the 115th minute, the use of multiple and high doses of inotropes in the previous hospital. However, as seen in case 1, if the patient comes to the hospital without CA, even if multiple organ failure develops and CRRT is applied, the patient can return to normal life with good care.

Conclusion

After butane gas inhalation, life-threatening systemic effects, especially cardiac, occur in children. This causes fatal or permanent neurological sequelae, especially as it causes out-of-hospital arrest. Although it does not have a special antidote, it can be ensured that patients survive with respiratory and circulatory support and regain normal health. In addition, the regulation of laws on the sale of volatile substances from government offices and educating the public on this issue by health professionals are among the measures to prevent adolescent deaths.

Ethics

Informed Consent: We was approved informed consent from the child's parents.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: A.G., T.K., Design: T.K., Data Collection or Processing: A.G., Analysis or Interpretation: A.G., T.K., E.B., E.G., Literature Search: A.G., E.B., E.G., T.K., Writing: A.G., T.K.

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