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Case Report

Suicide with Potassium Cyanide Bought on The Internet: A Case Report

İnternet Üzerinden Alınan Potasyum Siyanür İle İntihar: Olgu Sunumu

Hatice Kübra Ata Öztürk, Alper Akça, Ayşe Kurtuluş Dereli*

Abstract: Cyanide is one of the most toxic substances known. Although acute intoxication isn't common, suicide with cyanide often results in death. In this study, it was present a 27-year-old man who suicide by buying potassium cyanide from the Internet. A cup with white contamination was found at the scene and an invoice and a credit card payment slip documenting that he had purchased 1 kg of potassium cyanide from a company selling chemical materials over the internet. In autopsy, nonspecific findings such as submucosal congestion and focal fresh bleeding areas and severe hyperemia in other tissues were found and the toxicological examination revealed that he died of oral cyanide poisoning. This study is presented in order to draw attention to the fact that cyanide, which is the most toxic substance known, can easily be bought over the internet and to emphasize that access to these substances should be strictly controlled.

Keywords: Cyanide, poisoning, suicide, internet, autopsy

Öz: Siyanür bilinen en toksik maddelerden birisidir. Akut zehirlenmelerine sık rastlanmamakla birlikte siyanürle intiharlar sıklıkla ölümle sonuçlanır. Bu çalışmada; internet aracılığı ile alınan potasyum siyanür ile intihar eden 27 yaşındaki bir erkek olgu sunulmuştur. Olay yerinde beyaz renkli madde ile bulaşıklı bir adet su bardağı, internet üzerinden kimyasal malzemeler satan bir firmadan 1 kg potasyum siyanür satın aldığını belgeleyen fatura ve kredi kartı ödeme fişi bulunmuştur. Otopside özefagusta submukozal konjesyon ve fokal taze kanama alanları, diğer dokularda ağır hiperemi gibi nonspesifik bulgular olduğu görülmüş ve toksikolojik incelemede ağız yoluyla alınan akut siyanür zehirlenmesi nedeniyle öldüğü saptanmıştır. Bu olgu, bilinen en toksik madde olan siyanürün internet üzerinden kolaylıkla alınabilmesine dikkat çekmek ve bu maddelere erişimin sıkı bir şekilde denetlenmesi gerektiğini vurgulamak amacıyla sunulmuştur.

Anahtar Kelimeler: Siyanür, zehirlenme, intihar, internet, otopsi

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Hatice Kübra Ata Öztürk: R.A., MD. Pamukkale University, Faculty of Medicine, Department of Forensic Medicine, Denizli, Turkey
Email: drkrblk@outlook.com
ORCIDID:https://orcid.org/0000-0002-4875-0826

Alper Akça: R.A., MD. Pamukkale University, Faculty of Medicine, Department of Forensic Medicine, Denizli, Turkey
Email: replacka@gmail.com
ORCIDID:https://orcid.org/0000-0002-0239-4432

Ayşe Kurtuluş Dereli: Prof. Dr., Pamukkale University, Faculty of Medicine, Department of Forensic Medicine, Denizli, Turkey
Eposta: akurtulus76@yahoo.com
ORCIDID:https://orcid.org/0000-0002-0592-585X

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* Corresponding Author

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1. Introduction

Cyanide is a lethal and destructive poison, and has been defined by the Environmental Protection Agency (EPA) as the most toxic known substance (1, 2). Cyanide is an anionic poisonous chemical consisting of one C atom and one N atom joined with a triple bond. It forms salts with alkali cations, and ionic complexes with various metal cations (3). Its poisonous effects have been known in nature for a long time, although hydrogen cyanide was not isolated from Prussian blue until 1786 (4). It has solid, liquid and gaseous forms. Hydrogen cyanide (HCN) is colorless, and can take either a gaseous or liquid state. The salts of sodium, potassium and calcium cyanide are white in color (5). Cyanide is lighter than water and highly volatile in hot, dry temperatures, and has a boiling point of 26°C. It is easily diffused since it has a low molecular weight and is a volatile compound (4). Cyanide compounds have an odor resembling bitter almond, which can be detected at the threshold of 0.2–0.5 ppm (6), yet only 60% of the population can detect such an odor genetically (5).

Cyanide and cyanide salts are commonly used in a number of industrial processes, such as in the metal and plastic sectors, and in mining, gold extraction, painting and photography. Although it is a highly toxic and commonly used chemical, acute poisoning is rare, occurring when a cyanide-containing substance is ingested, inhaled or dermally absorbed. In humans, inhalation of 300 mg/m^3 cyanide is instantly fatal, while the inhalation of 120–150 mg/m^3 cyanide can lead to death within a few hours (2). A lethal dose for ingestion of KCN and NaCN compounds is 0.5–3.5 mg/kg (2). The lethal dose for transdermal exposures, in turn, is 100 mg/kg (7).

Cyanide-related deaths can result from accidents, suicide and even homicide. Accidental or industrial poisoning is possible, especially among those working in the metal and plastic industries, and in mining, gold extraction, painting, photography and agriculture. Suicide-related acute cyanide poisoning occurs typically through the ingestion of sodium cyanide or potassium cyanide (8). This study presents a case of suicide with potassium cyanide, which is easy to find and obtain online, and compares the findings with literature.

2. Case

History

Our case was a 27-year old male who was a final year civil engineering student. It was ascertained during the judicial investigation that he was living in accommodation with four friends, and was working part-time at a Turkish wrap (durum) restaurant due to financial troubles. His relationship with his family was poor, and he had been displaying symptoms of depression for a long time. He had mentioned suicide to his friends about 3 months previously, but had not sought medical treatment. On the day of the event, he told his flatmate that he had drunk cyanide 1 minute previously; he started to vomit and then had a seizure. He was taken to the hospital in a neighbor's vehicle, but was exitus at admission.

The crime scene investigation revealed a water glass contaminated with a white substance on the table in his room, along with a nearby teaspoon and a piece of paper saying "I AM TIRED". His wallet contained an invoice and credit card receipt indicating the purchase of 1 kg of potassium cyanide from an online chemical substances company.

Autopsy Findings

An external examination revealed pink-purple livor mortis on the back of the body in the supine position. There was a light red, diffuse fluid of a serohemorrhagic nature coming out of the mouth and nose. There were no signs of trauma on the body. Macroscopically, there were petechiae and a light red appearance on the scalp and on all serous membranes, petechiae on the brain and cerebellar tissues, erosion and a bleeding-related dark red-black color on the mucosa of the tongue, tongue base, uvula, epiglottis and esophagus, diffuse edema fluid in the trachea and main bronchi, and congestion and edema in the lungs (the left lung was 560 g and the right lung was 610 g). The blood was light red in color and liquid. Microscopically, there was submucosal congestion and areas of focal fresh bleeding in the esophagus, intraalveolar fresh bleeding and severe hyperemia in the lungs, severe hyperemia in the heart, and hyperemia in the liver, kidney, spleen and pancreas. A toxicological analysis using the HS/GC/MS method revealed 11.59 mg/l cyanide in the blood. Cyanide was identified in the intraocular fluid and lung tissue, and in the toxicological analysis performed on the sheet of paper, the water glass washing fluid and in the white crystal powder from the crime scene. Additionally, 51 ml/l ethanol, 22 ng/ml paracetamol and 7 ng/ml lidocaine were identified. Considering the crime scene investigation and postmortem macroscopic, microscopic and toxicological examination findings together, it was concluded that the person had died from to acute cyanide poisoning through ingestion. An investigation of the case at the Public Prosecution Office resulted in a verdict of non-prosecution due to suicide-origin death.

Ethical Declaration

Helsinki Declaration rules were followed to conduct this study and no ethical approval is need for this study.

3. Discussion

Cyanide can lead to poisoning as a result of intravenous injection, dermal absorption, inhalation or ingestion. Cyanide poisoning is associated, fundamentally, with the failure of oxygen use by tissues, although normal oxygen may reach the tissues, and the occurrence of cellular hypoxia. Cyanide binds to the ferric (Fe^{+3}) form of iron found in the structure of the mitochondrial cytochrome oxidase enzyme (cytochrome a3), and thereby inhibits this enzyme. The inhibition of the cytochrome oxidase enzyme ceases the reduction of oxygen to water, and thereby, the mitochondrial transport chain is blocked, in turn resulting in cellular hypoxia and ATP depletion. As a result, metabolic acidosis with an increased anion gap occurs, despite the normal partial pressure of oxygen in the blood. Respiratory and circulatory functions are impaired, resulting in death (2, 4, 9-11). Cyanide is metabolically inactivated primarily (about 80%) through the formation of thiocyanate catalyzed by the rhodanase enzyme in the liver, and thiocyanate is then passed in the urine (2).

The emergence of the clinical signs of cyanide-induced poisoning varies in accordance with the type, amount and method of cyanide used. It leads to death within seconds following inhalation or intravenous injection, within minutes following ingestion, and within a few hours following dermal absorption. Cyanide poisoning by inhalation is the most dangerous route due to its rapid absorption from the bronchial mucosa and alveoli. Ingested cyanide salts react with hydrochloric acid in the stomach and form HCN, and are quickly absorbed via the gastrointestinal tract. Upon absorption, cyanide spreads to all organs. In deaths from cyanide poisoning, the highest concentrations are in the liver, lungs, blood, spleen and brain (2, 9). The association between the blood concentrations of cyanide and the severity of symptoms have been defined as mild for 0.5–1 mg/l, moderate for 1–2 mg/l, severe for 2–3 mg/l and lethal for over 3 mg/l (12). The central nervous system is first to be affected. Main symptoms of mild cyanide poisoning include mental confusion, nausea, headache, dizziness, anxiety, perspiration and skin redness. For moderate poisoning, early symptoms include tachycardia, reflex bradycardia, tachypnea and dyspnea, while late symptoms include stupor and seizure. Severe poisoning symptoms, in turn, include paralysis, coma, hypotension, respiratory depression, mydriasis, S-T changes, ventricular fibrillation and asystole (5, 13). Among the lethal cases in literature, blood cyanide concentrations have been reported to be 3.0–80.9 mg/l in the five-case series by Musshoff et al., 5.3 mg/l in another study by Musshoff et al., 72 mg/l in a study by Le Graff et al., and >2 mg/l in a study by Koçak et al. (6, 13–15). In our case, the blood concentration of cyanide was 11.59 mg/l, detected in the toxicological analysis, which was observed to be lethal.

Our case died after he had told his friend that he had drunk cyanide 1 minute previously. For lethal cyanide dose intakes, and especially in forensic cases, knowledge of the ability and duration of movement is highly important for the crime scene re-enactment and the decision on origin. In most cases, the duration of mobility following cyanide ingestion is reported to be few seconds to 1 or 2 minutes, although there have been some cases with a mobility duration of 5–10 minutes (6, 16).

In cyanide poisoning cases, autopsy findings are typically non-specific, with the most specific finding during autopsies being a bitter almond odor. Nevertheless, the absence of such odor does not mean that death is not caused by cyanide poisoning, as the ability to detect such an odor differs from person to person due to genetic causes (5). Livor mortis and blood color may be light–bright red due to the excess oxygen in the circulating blood. Such a finding, however, is not specific to cyanide poisoning, and may not be always observed in deaths from cyanide (5). The most common autopsy findings include congested visceral tissue, congested and edematous lungs, and erosion, ulceration, and bleeding in the esophageal and gastric mucosa if the cyanide has been ingested (15). The microscopic findings observed in cyanide cases are ischemic changes in the brain, and particularly in the globus pallidus, intraalveolar fresh bleeding areas in the lungs, fresh bleeding areas in the myocardium, and parenchymatous changes in the liver and kidneys (5). The study by Koçak et al. reported extreme edema in the brain and punctual bleeding foci in white matter, extreme edema in both lungs and intraparenchymal bleeding in the upper lobe of the right lung (13). The study by Karadeniz et al. reported a diffuse edema and congestion, and a light pink appearance in lungs; a diffuse erosive appearance in the stomach, along with histopathological examination findings of generalized hyperemia in all visceral organs; acute swelling and intraalveolar fresh bleeding areas in the lungs; and diffuse fresh bleeding in the myocardium (4). No bright red color in the skin was observed in the said case, although the blood was observed to be light red in color and liquid. Only one of the autopsy team stated the detection of a mild bitter almond odor. There were congested and edematous lungs, and congestion and

hyperemia in the other visceral organs. Due to the ingestion of cyanide, erosion and bleeding was noted in the buccal and esophageal mucosa. A microscopic examination revealed no particular findings in the brain, although fresh bleeding areas were noted in the lung and hyperemia in the heart. Overall, the autopsy findings of the said case were found to be consistent with the non-specific findings defined for cyanide poisoning (4, 8, 13, 15).

A review of previous retrospective studies revealed few cases of cyanide use for suicide (17-19). Zhang et al. identified cyanide poisoning in only 15 of 565 autopsies conducted between 2000 and 2010 (17). Likewise, Gallagher et al. found cyanide poisoning to be rare, other than from occupational exposure (18). Liang et al. stated that the number of cyanide poisoning cases was very low compared to other types of poisoning (19). The intake of cyanide in suicide attempts may occur more frequently in people with easy access to cyanide, such as healthcare and laboratory personnel. The study by Musshoff et al. reported a 38-year-old male case ingesting cyanide in an attempt to commit suicide who was employed as a jeweler (6). The same study identified a 71-year-old physician together with their spouse, a 70-year-old person with a chemist spouse, and a 29-year-old laboratory technician who ingested cyanide in a suicide attempt (6). The study by Koçak et al. established that a 60-year-old male jeweler had died due to the accidental ingestion of cyanide (13). The use of cyanide in suicide attempts may also involve injection or inhalation, although these routes are more uncommon. A study by Musshoff et al. reported that a 48-year-old case was found dead in his car after being exposed to cyanide by inhalation, with a suicide verdict recorded (14). Another study reported that a 91-year-old male used cyanide through subcutaneous injection in a suicide attempt (20). Likewise, Prieto et al. reported a 30-year-old female case with a history of depression who committed suicide by subcutaneously injecting cyanide (21). The National Forensic Service (NFS) in Seoul, Republic of Korea, made a retrospective investigation of 255 cyanide poisoning cases between 2005 and 2010, and different from other studies, found that the most common cause of cyanide poisoning in the Republic of Korea was suicide, the vast majority (98.8%) of which involved ingestion. The same study determined that the mean age was 41.88±13.09 years, the number of male cases was higher and place of residence was the most common location of suicides (22).

The present study reports on a case who committed suicide after gaining easy access to a large amount (1 kg) of potassium cyanide online. As exemplified in the present case, the Internet has become a source for the purchase of almost anything, including controlled toxic chemical substances. It is understood that individuals with no knowledge of chemical substances can easily access online information, and can obtain the necessary substances and use them to commit suicide (14). Literature contains two cases of suicide in which cyanide was bought online, one from a dark web source (15, 23). Applying controls to the sale and procurement of cyanide, which is a highly toxic substance with potential for use in both individual and mass deaths, through legal purchases has been regarded necessary. In our country, a legal framework has been established for the trade of chemical substances like cyanide under the "Regulation on Controlled Chemical Substances", published in the Official Gazette dated 16/06/2004 and No. 25494. This regulation was entered into effect to identify the distribution channels and the end user, to understand for what purposes such controlled chemical substances that involve multiple domestic stages of sale are used and to prevent their illegal use. Under the Regulation, the purchaser must to complete a "Customer/End User Declaration" form prior to the procurement of any chemical substance, requiring such information as the intended purpose of use and the quantity of the chemical substance to be purchased, as well as a valid address. That said, it is believed that stricter rules should be applied for cyanide purchases, with strict supervision needed to ensure the rules are followed as a means of preventing abuse and poisoning.

References

1. Chin R.G., Calderon Y. "Acute Cyanide Poisoning: A Case Report", The Journal of Emergency Medicine, 18, 441-445, 2000. https://doi.org/10.1016/S0736-4679(00)00161-X
2. Hydrogen cyanide, potassium cyanide and sodium cyanide. Erişim tarihi: 25/09/2019 https://doi.org/10.1002/3527600418.mb7490vere0019
3. Çabuk A, Kolankaya N. Siyanürün Toksisitesi ve Biyolojik Yıkımı, Sigma 2012;30: 20-38.
4. Karadeniz H, Birincioğlu İ, Zazoğlu S, Ketenci HÇ. Siyanür zehirlenmesi ile meydana gelen ölümlerde toksikolojik analizin önemi: Olgu sunumu, Adli Tıp Dergisi 2017;31(2):96-100 https://doi.org/10.5505/adlitip.2017.72677
5. Renklidağ T, Karaman AG. Siyanür Zehirlenmesi. Sted 2003;12(9):350-3.
6. Musshoff F, Schmidt P, Daldrup T, Madea B. Cyanide fatalities: case studies of four suicides and one homicide. Am J Forensic Med Pathol. 2002 Dec;23(4):315-20. https://doi.org/10.1097/00000433-200212000-00002
7. Inna Leybell, MD. Cyanide Toxicity, updated Jan 02, 2018, emedicine.medscape.com/article/814287

8. Knight B, Saukko P. Knight's forensic pathology. 4th Ed. New York: Taylor & Francis Group 2016:623-624 https://doi.org/10.1201/b13266
9. Thomas A. Gossel, Bricker DJ. Principles of Clinical Toksicology 1984 Cyanide syf:90-94
10. Huzar TF, George T, Cross JM. Carbon monoxide and cyanide toxicity: etiology, pathophysiology and treatment in inhalation injury. Expert Rev Respir Med. 2013 Apr;7(2):159-70. https://doi.org/10.1586/ers.13.9
11. Hsiao PJ, Chang CF, Chiu CC, Chan JS, Chiang WF, Wu CC, et al. High Anion Gap Metabolic Acidosis after a Suicide Attempt with Cyanide: The Rebirth of Cyanide Poisoning. Intern Med 2015;54(15):1901-4. https://doi.org/10.2169/internalmedicine.54.4272.
12. Anseeuw K, Delvau N, Burillo-Putze G, De Iaco F, Geldner G, Holmström P, et al. Cyanide poisoning by fire smoke inhalation a European expert concensus. Eur J Emerg Med. 2013 Feb;20(1):2-9. https://doi.org/10.1097/MEJ.0b013e328357170b
13. Koçak S, Zerrin Defne Dündar ZD, Demirci Ş, Cander B, Doğan H. Siyanür Zehirlenmesi: Olgu Sunumu. AKATOS 2010; 1(1): 11-4 https://doi.org/10.5505/jaemcr.2010.08208
14. Musshoff F, Kirschbaum KM, Madea B. An uncommon case of a suicide with inhalation of hydrogen cyanide. Forensic Sci Int. 2011 Jan 30;204(1-3):e4-7. https://doi.org/10.1016/j.forsciint.2010.05.012.
15. Le Garff E, Delannoy Y, Mesli V, Allorge D, Hédouin V, Tournel G. Cyanide Suicide After Deep Web Shopping: A Case Report. Am J Forensic Med Pathol. 2016 Sep;37(3):194-7. https://doi.org/10.1097/PAF.0000000000000241.
16. Vock R, Magerl H, Lange O, Betz P, Eisenmenger W, Freislederer A, et al. Handlungsfähigkeit bei tödlichen oralen Intoxikationen mit Cyan-Verbindungen. Rechtsmed 1999;9:56–61. https://doi.org/10.1007/s001940050080
17. Zhang D, Zhang J, Zuo Z, Liao L. A retrospective analysis of data from toxic substance-related cases in Northeast China (Heilongjiang) between 2000 and 2010. Forensic Sci Int. 2013;231:172–177. https://doi.org/10.1016/j.forsciint.2013.05.014
18. Gallagher LM, Kappatos D, Tisch C, Ellis PM. Suicide by poisoning in New Zealand—a toxicological analysis. NZMedJ. 2012;125(1362):15–25.
19. Liangh M, Zheng N, Zhou L, Liu Q, Zhang HD, Zhuo L, et al. Comparative analysis of 607 autopsy cases of poisoning death, Fa Yi Xue Za Zhi. 2011;27(3):200-204.
20. Eroğlu MZ, Güneş T, Nebioğlu M. Suicide Attempt by Subcutaneous Injection of Cyanide: A Case Report. Düşünen Adam The Journal of Psychiatry and Neurological Sciences 2014;27:257-60, https://doi.org/10.5350/DAJPN2014270310
21. Prieto I, Pujol I, Santiuste C, Poyo-Guerrero R, Diego A. Acute cyanide poisoning by subcutaneous injection. Emerg Med J. 2005 May;22(5):389-90. https://doi.org/10.1136/emj.2004.016915
22. Lee SK, Rhee JS, Yum HS. Cyanide poisoning deaths detected at the national forensic service headquarters in seoul of Korea: a six year survey (2005~2010). Toxicol Res. 2012 Sep;28(3):195-9. https://doi.org/10.5487/TR.2012.28.3.195.
23. Sommerfeld K, Łukasik-Głebocka M, Górny J, Tobolski J, Zielińska-Psuja B. Suicidal poisoning with cyanide bought on the internet--case report. Przegl Lek. 2012;69(8):572-4.