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Poisoning with e-cigarette liquid (VPG Power Smoke Baze) - case report

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Summary:

Introduction and purpose: E-cigarettes have emerged as an alternative to traditional tobacco smoking. Toxicological studies have investigated the composition and potential toxicity of e-cigarette liquid components. While they are generally considered less harmful than combustible cigarettes, cases of poisoning associated with e-cigarette liquid ingestion or exposure have been reported.

Brief description of the state of knowledge: Nicotine intoxication resulting from e-cigarette liquid ingestion can lead to a range of symptoms and complications, including cardiovascular effects, neurological symptoms, gastrointestinal disturbances, respiratory issues, and even death. This report presents a case of a 58-year-old woman hospitalized in the Toxicology and Cardiology Department due to poisoning with e-cigarette liquid.

Conclusions: Accidental or intentional ingestion and/or injection of e-liquid is becoming a new emerging challenge for Emergency Medicine, mainly because of the easy accessibility of advertisements and the sales of e-cigarettes online, and the high nicotine concentration

in e-liquids. It is important to report instances of e-liquid-related nicotine intoxication in order to improve the legal restrictions on the sale of e-liquid.

Key words: e-liquid, intoxication, nicotine, e-cigarette, poisoning

1. Introduction

E-cigarettes, also known as electronic nicotine delivery systems (ENDS), have emerged as an alternative to traditional tobacco smoking. Toxicological studies have investigated the composition and potential toxicity of e-cigarette liquid components. They typically contain a mixture of nicotine, propylene glycol, glycerin, flavorings, and other additives [1]. While they are generally considered less harmful than combustible cigarettes, cases of poisoning associated with e-cigarette liquid ingestion or exposure have been reported. This report presents a case of a 58-year-old woman hospitalized in the Toxicology and Cardiology Department due to poisoning with e-cigarette liquid.

2. Case report

A 58-year-old female with a medical history of adaptive disorder co-located from another hospital's emergency department was admitted to the Toxicology and Cardiology Department due to E-cigarette liquid intoxication (VPG Power Smoke Baze) – containing nicotine. In the hospital emergency department, gastric lavage was performed and activated charcoal was administered. The medical history shows that the patient had taken several tens of milliliters of the preparation 12 hours before arriving at the hospital. The nicotine content of the liquid is 12 mg/ml. The patient confirms intentional ingestion. One week before the incident, the patient attempted suicide by self-injury in the wrists area and elbow pits. She was hospitalized in a psychiatric hospital and discharged at her own request after two days. On the day of admission, the patient claimed that all her problems were related to

hypothyroidism therapy. On admission, the patient was in average general condition, with efficient cardiopulmonary function, conscious, periodically incoherent, and presenting a significantly lowered mood. Vital parameters: oxygenation 100%, HR 75/min, RR 115/80 mmHg. A 12-lead ECG (electrocardiogram) was performed which showed no significant abnormalities.

Table 1: Blood morphology tests

Hematology	First day of hospitalization	Third day of hospitalization
RBC [4-5.20] [mln/µ]	2.7 L	2.9 L
HGB [12-16] [g/dl]	8.2 L	8.5 L
HCT [37-49] [%]	24.9 L	26.2 L
Leu [4.3-10] [10^3/µl]	9.6	4.7
MCH [27-34] [pg]	30	29.5
MCHC [32-36] [g/dl]	32.8	32.3
MCV [80-99] [fl]	92	91
MPV [7-11] [fl]	8.4	7.9
PLT [150-400] [10^3/µl]	260	299
RDW-CV [11.50-14.50] [%]	16 H	15.1 H

Table 2: Biochemistry tests

Biochemistry	First day of hospitalization
Creatinine [0.50-0.90] [mg/dl]	0.61
Urea [15-46] [mg/dl]	14.64 L
AST [5-32] [U/l]	13
ALT [5-31] [U/l]	11
Glucose [70-110] [mg/dl]	66.6 L
Na^+ [135-145] [mmol/l]	143
K^+ [3.50-5.10] [mmol/l]	3.8
Cl^- [98-107] [mmol/l]	106
Mg^{2+} [0.7-1] [mmol/l]	0.8
pH [7.35-7.45]	7.338
pCO_2 [38.90-48.90] [mmHg]	47.4
BE(B) [-3-3] [mmol/l]	-1
pO_2 [75-100] [mmHg]	23.6 L
Oxygenation [95-98] [%]	36.5 L
HCO_3 [21-25] [mmol/l]	24.8
tCO [22-26] [mmol/l]	24.2
CRP [0-5] [mg/l]	1.96
CK [26-192] [U/l]	63

Table 3: Coagulation tests

Coaguology	First day of hospitalization	Second day of hospitalization
PT [9.40-12.50] [sec]	13 H	
INR [0.80-1.15]	1.19 H	
APTT [25-36] [sec]	29	
D-dimers [0-0.50]		0.86 H

Table 4: TSH test

Hormones	First day of hospitalization
TSH [0.27-4.20] [mIU/l]	14.61 H

During hospitalization, the patient was consulted by a psychologist and a psychiatrist, who performed a clinical-psychiatric assessment of the patient's mental state. Approximately five years ago, the patient was diagnosed with hyperthyroidism, which progressed to hypothyroidism six months ago. Since then there have been constant mood changes, increased lethargy, general unwellness, and a feeling of chronic fatigue. She is not taking the recommended medication, claiming that it is harming her. During the conversation with the psychiatrist, the patient reported that both suicide attempts were related to her inability to cope with the symptoms of hypothyroidism. Treatment included: 0,9% NaCl, 5% Glucose, KCl, Magnesium Sulfate, Omeprazole, Dexamethasonum, Betaloc, Atropine, Euthyrox, Relanium, and Midanium. On the fourth day in a state of clinical recovery, the patient was discharged from the Toxicology and Cardiology Department and transported by medical transport to the Neuropsychiatric Hospital.

3. Discussion

The study by Jensen et al. [2] aimed to investigate the levels of formaldehyde, a known carcinogen, in e-cigarette aerosols. The findings revealed that e-cigarettes produced levels
of formaldehyde at high-voltage settings that were significantly higher than the levels considered safe for human inhalation. The researchers observed that under certain conditions, the amount of formaldehyde released from e-cigarettes was comparable to or even higher than the levels found in conventional tobacco cigarettes.

A study from 2017 investigates the presence of toxic and potentially carcinogenic metals in e-cigarettes [3]. The researchers analyzed the aerosol samples from a variety of e-cigarette brands using different heating elements, as well as the e-liquids used in these devices. The findings of the study indicated that the aerosol generated by e-cigarettes contained several toxic and potentially carcinogenic metals, including lead, chromium, nickel, and cadmium.

The study highlighted the potential health risks associated with inhaling these metals, as they can accumulate in the respiratory system and have adverse effects on human health. Chronic exposure to these metals has been linked to respiratory and cardiovascular diseases, as well as an increased risk of developing certain cancers.

Another study conducted by researchers from the USA is a brief report that highlights the trends and characteristics of calls made to Poison Centers in the United States regarding exposures to electronic cigarettes (e-cigarettes) during the period from September 2010 to February 2014 [4]. The study indicated a significant increase in the number of calls to poison centers during the studied period, with the majority of exposures involving children aged five years or younger. The most common route of exposure was ingestion of e-cigarette liquids, which often resulted in symptoms such as vomiting, nausea, and eye irritation. The report also noted a small number of cases involving inhalation or eye contact with e-cigarette liquid.

The study by Maessen et al. examines various case reports of nicotine intoxication resulting from e-cigarette liquid ingestion [5]. The findings of the study revealed that nicotine intoxication resulting from e-cigarette liquid ingestion can lead to a range of symptoms and complications, including cardiovascular effects, neurological symptoms, gastrointestinal

disturbances, and respiratory issues. The severity of symptoms varied among cases, and some individuals required intensive care and respiratory support. They found 26 case reports describing a total of 31 patients who suffered from e-liquid intoxication. All intoxications up to the age of six were reported as unintentional, whereas nearly all cases from ages 13 to 53 were due to suicide attempts. The three most prevalent symptoms of e-liquid intoxication were tachycardia, altered mental status, and vomiting. Eleven cases resulted in the death of the patient. In the survivors, the highest plasma concentration of nicotine was 800 μg L^{-1}, while the lowest concentration in the non-survivors was 1600 μg L^{-1}.

Another study conducted by Italian researchers is a retrospective evaluation of the scientific literature from the PubMed database, in the last 10 years from 2010 to 2020 focused on severe neurological nicotine intoxication cases associated with e-cigarette liquids, the final data set consisted of 33 papers for a total of 38 patients [6]. Publications were scattered around the world (most of the published cases were from the United States, but other publications were from various countries across Europe. In most of these cases (N = 31), the poisoning followed nicotine ingestion alone, while nicotine had been taken both by ingestion and injection (N = 4) or by injection alone (N = 3) in a few cases. Of the 38 reported cases of e-liquid intoxication, 9 were found to be dead by the emergency team. The study highlighted numerous symptoms of nicotine intoxication in the early stages, symptoms usually mimic stimulant toxicity with nausea and vomiting, excessive salivation, abdominal pain, pallor, sweating, hypertension, tachycardia, ataxia, tremor, headache, dizziness, muscle fasciculation, seizures and diffuse vasoconstriction and thrombosis of the cerebral microvascular system. Later, neurological depressor effects such as hypotension, bradycardia, CNS depression, coma, muscular weakness or paralysis, and respiratory failure, as far as cardiac arrest (CA), usually become prevalent.

A case report of a 23-year-old man presented with a sudden loss of consciousness, bradycardia, and respiratory muscle paralysis after an intentional ingestion of e-liquid was presented by Italian authors in 2020 [7]. Early clinical data, brain computed tomography, and neurophysiological tests did not show features with a poor neurological prognostic meaning of hypoxic encephalopathy. After 4 days, the patient showed bilateral loss of the pupillary reflex, and severe cytotoxic edema was detected on brain magnetic resonance imaging. SEPs showed a bilateral loss of cortical responses and EEG a suppressed pattern. Nine days after the onset of the coma, the patient evolved toward brain death.

An important aspect to note is the prevalence of poisoning by tobacco-containing products among children and adolescents. The author of this work [8] points out the problem of the occurrence of unintentional poisoning in young children caused by oral ingestion of nicotine compounds. This is related to the attractiveness of the aromatic solutions used in e-cigarettes, which are not properly protected from children. A significant issue required to be undertaken to protect children from contact with nicotine-containing substances and their effects in the form of poisoning is still increasing public education and increasingly better solutions related to the safety of products used for e-cigarettes [9]. In addition, it is necessary to evaluate measures to effectively reduce children's contact with tobacco products of all forms [10].

4. Conclusions

Accidental or intentional ingestion and/or injection of e-liquid is becoming a new emerging challenge for Emergency Medicine, mainly because of the easy accessibility of advertisements and the sales of e-cigarettes online, and the high nicotine concentration in e-liquids. Our case and other scientific papers mentioned in our report show the importance of public awareness, regulation, and safety surrounding e-cigarette liquid use. The ages of the patients display a bimodal distribution. In patients above the age of 10, intoxication results mainly from suicide attempts rather than accidental ingestion. Finally, it is important to emphasize that no antidote therapy for the treatment of nicotine intoxication currently exists. In fact, Mecamylamine (Inversine), a specific antagonist of nicotine action, is available only
in tablets, a form that is not suitable for patients who are vomiting, convulsing, or hypotensive.

Author Contributions

Conceptualization, M.W and M.Z.; methodology, D.G.; validation, M.Z; investigation, M.W., D.G. and M.Z.; resources, D.G. data curation, M.W.; writing—original draft preparation, M.Z.; writing—review and editing, M.W. and M.Z.; visualization, D.G.; supervision, D.G.; funding acquisition, not applicable.

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Data Availability Statement

Data and material will be available upon completion of this study on request.

Conflicts of Interest

The authors declare no conflict of interest.

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Supplementary materials

Table 1: Blood morphology tests

Table 2: Biochemistry tests

Table 3: Coagulation tests

Table 4: TSH test