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The Silent Danger Encountered in the Early Period After the 2023 Kahramanmaraş -Türkiye Earthquake: Carbon Monoxide Poisoning

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ABSTRACT

Introduction: Carbon monoxide (CO) poisoning is a clinical condition that is difficult to diagnose. It is encountered more frequently and is more challenging to diagnose during disasters, where clinicians are primarily focused on health problems directly caused by the disaster, and living conditions are harsh and deviate from standard living conditions.
Objective: This study aims to examine carbon monoxide poisoning, one of the dangers that may arise from deteriorated living conditions following disasters, and to draw attention to this insidious threat.
Method: The study included patients who were admitted to the emergency department with suspected carbon monoxide poisoning after the major earthquake on February 6 in Hatay province, and whose preliminary diagnoses were confirmed by blood gas tests. General characteristics of the patients, such as age and gender, their prognosis, and treatments received were obtained by retrospectively reviewing hospital records. The data were analyzed using the SPSS 23 program.
Results: After the February 6 earthquake, 61.1% of the patients who applied to the emergency clinic with CO poisoning were women, and 63% of them built shelters with their own means and created their own heating facilities. It was determined that the fire lit inside the shelter was lit for heating purposes.
Conclusion: As a result of the adverse development of seasonal conditions immediately after the earthquake, it was seen that people affected by the earthquake tried to meet their heating needs with their own means and that shelters such as tents or huts were especially dangerous. It is recommended that people affected by the earthquake be warned about this issue through mass communication means.

Keywords: Disaster, Earthquake, Carbon Monoxide, Tent, Temporary Shelters.

INTRODUCTION

Carbon monoxide (CO) is one of the environmental pollutants that requires control measures for preventing exposure and monitoring levels in order to protect public health. It is a colorless, odorless, toxic gas that is a byproduct of incomplete combustion of carbon-containing fuels. Major sources of carbon monoxide gas include motor vehicles, heaters, devices using carbon-containing fuels, paints containing methylene chloride, and fires (1). In the United States, carbon monoxide (CO) poisoning ranks among the leading causes of mortality and morbidity due to poisoning. Additionally, there are approximately 50,000 cases annually in the United States, with mortality rates reaching 1% to 3% (2).

The global incidence of CO poisoning, whether intentional or accidental, is often poorly determined due to the temporary nature of clinical symptoms in mild cases or the fact that CO poisoning may not be considered as a preliminary diagnosis at the time of the initial hospital visit (3). The clinical symptoms of acute CO poisoning can range from headache and flu-like symptoms to loss of orientation and consciousness, cardiac angina, and even death (4). The non-specific nature of the clinical signs and the focus of healthcare services on the disaster and its direct effects during emergencies make diagnosing CO poisoning more challenging in such situations.

The Organization for Economic Co-operation and Development (OECD) highlights the spatial and physical impacts on vital areas such as housing, infrastructure, and agricultural systems when assessing

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the effects of natural disasters. The spatial and physical changes that occur, along with the adjustment process that inevitably follows, can lead to various health problems (5).

When earthquake victims whose living spaces have been damaged live in tents distributed for their shelter needs or in shelters they have built with their own means, CO poisonings increase in number and may appear as potential health problems. If care is not taken, these increasing cases may not be diagnosed.

METHODS

After the first earthquakes of 7.6 and 7.7 magnitude on February 6, 2023, a retrospective evaluation of CO poisoning cases admitted to the emergency department of Hatay Mustafa Kemal University Hospital until the hospital was evacuated by the second earthquake on 20.02.2023 was aimed. Institutional permission from the hospital where the research was conducted and ethical approval from the Hatay Mustafa Kemal University Ethics Committee (ethics committee date: 03.09.2024, decision no: 31) were obtained for the conduct of the study.

The normality of data distribution was assessed using the Kolmogorov-Smirnov test, and it was found that the data did not follow a normal distribution. The Mann-Whitney U test was used to compare characteristics between two independent groups when the data did not have a normal distribution. Variables were examined using Spearman's rho correlation coefficient. Descriptive statistics included mean ± standard deviation, minimum, and maximum for numerical variables, and counts and percentages for categorical variables. Statistical analyses were performed using SPSS 23.0, and a p-value of <0.05 was considered statistically significant.

After the earthquake on February 6, 2023, 56 patients who were admitted to Hatay Mustafa Kemal University Hospital in the first 15 days after the earthquake on February 6, 2023, who were thought to have CO intoxication as a result of clinical evaluation and whose preliminary diagnosis was confirmed by blood gas tests were reached. Two patients whose laboratory values or epicrisis could not be reached were excluded from the study and the study was completed with 54 patients. Consent was not obtained from the patients.

RESULTS

Between February 6, 2023, and February 20, 2023, a total of 6,774 patients with various complaints were admitted to the Emergency Department, and among these, 54 patients met the inclusion criteria for the study and were diagnosed with carbon monoxide poisoning. In the previous year's records, the total number of CO poisoning cases was 4. Analysis revealed that 33 of the CO poisoning cases (61.1%) were female, 34 patients (63%) were living in temporary shelters they found on their own, while 20 patients (37%) were housed in tents provided by aid organizations or set up with their own means immediately after the earthquake. The average age of the cases was 27.92 (average age of women: 27, average age of men: 12, min: 1, max: 68). The average initial COHb level was 12.10% (min: 0.40, max: 31.20), and 98% of the cases received O2 therapy and were discharged without referral to an external center, with only one case being referred to an external facility. When evaluating the patients who presented to the emergency department, the average number of people affected together in a tent or shelter was 7.4 (min: 1, max: 13). It was found that the source of CO for all included cases was heating devices. Details of the participants' demographic and clinical characteristics are provided in Table 1.

Table 1. Demographic and Clinical Characteristics of Participants

		n (%)
Gender	Male	21(38.9)
	Woman	33(61.1)
Place of Stay	Shelter	34(63.0)
	Tent	20(37.0)
Treatment Received	O_2 (with mask)	53(98.1)
	Hyperbaric Oxygen Therapy	1(1.9)
CO source	heating equipment	54(100)

When comparing the participants' gender, age, COHb levels, and the average number of people affected in the same incident by the location of poisoning, it was found that the average age of women was 27 and the average age of men was 12, with no significant relationship between gender and age. However, when examining the average age by the location of poisoning, those poisoned in shelters they constructed themselves had an average age of 27.5, while those poisoned in tents had an average age of 17. Looking at the average initial COHb levels, men had an average COHb level of 15.20%, while women had an average of 8.6%. The analysis revealed a significant difference in COHb level averages between genders (p = 0.049). When examining the average COHb levels of individuals staying in shelters and tents, it was found that those staying in tents had higher COHb levels. Detailed values regarding participants' age, COHb levels, and the number of people affected by gender and poisoning location are provided in Table 2.

Table 2. Comparison of the Participants' COHb Level and the Average Number of People Affected by the Same Event According to Gender and the Environment in Which it is Affected

		Age (median ort)	U/P	Cohb (median ort)	U/P	Number of People Affected Together (median mean)	U/P
Gender	Male	12	U=256.5	15.20	*U=225.5	6	U=306.0
	Woman	27	P=0.110	8,60	**P=0.049	12	P=0.464
The place where he was poisoned	A blessing	27.50	U=299.0	9	U=290.0	6	U=336.0
	Tent	17	P=0.462	13.45	P=0.370	12	P=0.462

When comparing the COHb levels of disaster survivors affected by CO, the number of people affected together, and their ages using Spearman's rho correlation, no significant relationship was found between COHb levels and age or the number of people poisoned together. However, a significant relationship was found between age and the number of people affected in the same incident (p = 0.007, r = -0.362). This indicates a moderate negative correlation between age and the number of people affected together in the same incident (Table 3).

Table 3. Correlation Table of Participants' Clinical Characteristics

		COHb	Number of People Poisoned Together	Plastic
COHb level	r	1.000	0.074	-0.125
	p	.	0.597	0.366
Number of People Affected Together	r	0.074	1.000	-0.362**
	p	0.597	.	0.007
Age	r	-0.125	-0.362**	1.000
	p	0.366	0.007	.

DISCUSSION

CO is imperceptible but is a deadly toxin. There are no pathognomonic signs or symptoms for CO poisoning. Flushed cheeks have occasionally been considered a clue, but they are neither sensitive nor specific for diagnosis. Oxygen saturation measured with routine pulse oximeters and arterial blood gases is often normal, and diagnosis is typically made with a multi-wave pulse oximeter or by showing increased carboxyhemoglobin levels on a co-oximeter (6). Due to its non-specific symptoms, CO poisoning can be difficult to detect and may be overlooked, especially in situations where the focus is on other issues, such as during a disaster. In our study, 54 patients were identified within 15 days after the earthquake, which is above the normal incidence. This suggests that there may be many more undetected cases due to the difficulty in diagnosing CO poisoning.

A study conducted after the major East Japan earthquake in 2011 examined patients affected by CO poisoning following the disaster. When patients were categorized into those from the affected area and those from outside the disaster zone, it was found that the number of patients in the affected area after the disaster was higher compared to the pre-disaster period (number of patients after the disaster: 135 – number of patients before the disaster: 18) (7). The increase in CO poisoning cases following the disaster was also observed in our study. In the study conducted by Nakajima and colleagues, patients were categorized into those from the disaster area and those from outside the disaster area. This categorization suggested that the increase in CO poisoning cases was related to the disaster. In our study, there was no

area defined as outside the disaster zone. All patients presenting to the emergency department were considered as affected by the disaster.

From February 6, 2023, the 14-day temperature tracking shows that the lowest nighttime temperature was -2°C. The 14-day average weather conditions indicated that it was generally rainy with an average temperature of 5-6°C (Figure 1) (8). Based on seasonal conditions and meteorological records, it can be inferred that people might have been exposed to CO while trying to meet their heating needs due to the cold weather.

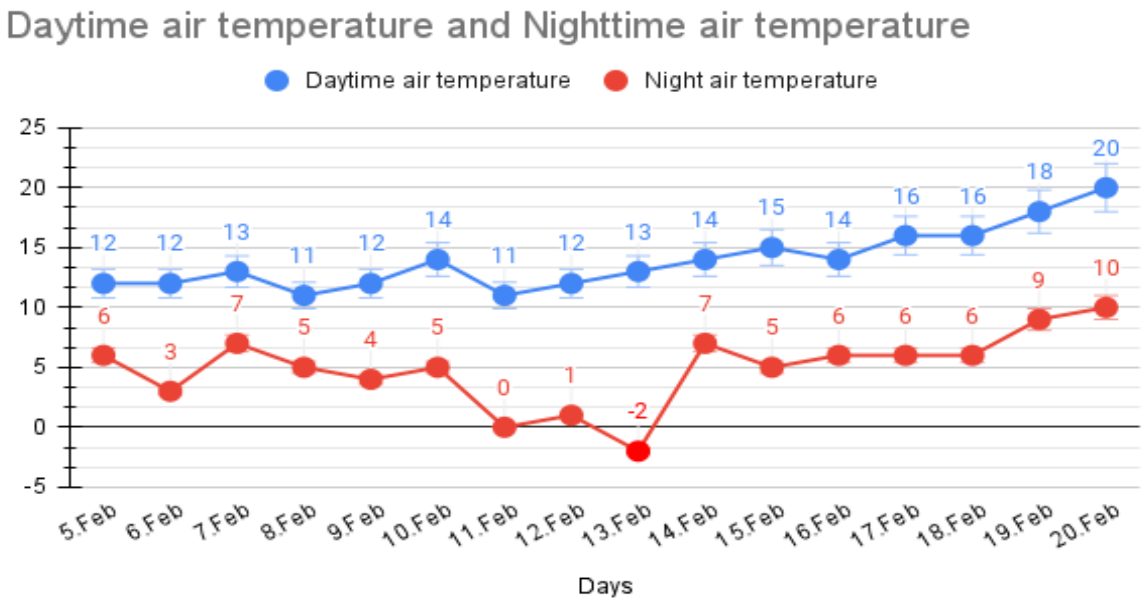

Figure 1. 16-Day Temperature Graph for Hatay Antakya District.

In a study by Heidari et al., it was reported that a significant number of CO poisoning cases were observed in temporary shelter camps and tents set up after disasters each year. They noted that CO poisoning increases during cold seasons due to the use of generators and heating devices, especially following power outages and fuel shortages after disasters. The study aimed to highlight the seasonal increases in cases (9).

In our study, it was observed that the source of CO in all cases was heating devices. During disasters, fundamental needs such as shelter and heating are associated with health problems as well.

In a study by Osamu Tokumaru and colleagues, health problems encountered in shelters after disasters were discussed, along with the common risks associated with communal living. After the Great Japan Earthquake, more than 470,000 people had to live in local shelter centers. During this period of changed living standards, issues such as inadequate sanitation, increased infectious diseases, exacerbation of chronic conditions, and health problems due to nutritional deficiencies were highlighted (10). Although some health problems that may arise in emergency communal living environments have been discussed, CO poisoning was not mentioned. However, as observed in our study, CO poisoning in emergency living areas can affect multiple people simultaneously. In this study, the number of people affected by CO in the same living area was recorded as a minimum of 3 and a maximum of 11.

Studies have shown that in 20% of CO poisoning cases, the process progresses from acute to chronic, and approximately 10% of these cases may develop delayed neurological symptoms. Some studies categorize the clinical periods after CO exposure into hyper-acute phase (first 24 hours), acute phase (24 hours to 7 days), subacute phase (8 to 21 days), and chronic phase (day 22 and beyond). It is believed that the COHb level does not have a significant effect on predicting this clinical prognosis (11). In our study, COHb levels of the patients were determined, but information about late effects and the clinical conditions of the patients was not included. Considering the long-term effects of CO poisoning, the lack

of assessment of the magnitude of health problems it may create can be considered a limitation of our study.

CONCLUSION

In major disasters such as earthquakes, people are exposed to living conditions they are not accustomed to, which brings about many health problems. In this context, it is important for physicians planning treatment and nurses providing care to remain vigilant about hard-to-diagnose conditions like CO poisoning, especially when trauma injuries are the primary focus. In this regard, while treating trauma in emergency patients, both physicians and nurses who are closely involved with the patient should be cautious. Physicians should carefully plan their treatment without overlooking potential cases, while nurses, as practitioners, should closely observe patient symptoms and collaborate with physicians in suspected cases. Additionally, considering the possibility of such cases during disaster preparedness, individuals should be advised about heating devices, and measures should be taken in emergency living areas during earthquakes. It is also recommended to frequently alert disaster survivors about CO poisoning using social media or mass communication channels.

DESCRIPTIONS

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REFERENCES

1. Varon J, Marik PE, Fromm RE Jr, Gueler A. Carbon monoxide poisoning: a review for clinicians. The Journal of emergency medicine. 1999;17(1):87-93.

2. Fucili G, Brauzzi M. Tips for avoiding common mistakes in out-of-hospital diagnosis of carbon monoxide poisoning. J Anesth Analg Crit Care. 2022;2(1):14.

3. Sircar K, Clower J, Shin MK, Bailey C, King M, Yip F. Carbon monoxide poisoning deaths in the United States, 1999 to 2012. The American journal of emergency medicine. 2015;33(9):1140-1145.

4. Eichhorn L, Thudium M, Jüttner B. The Diagnosis and Treatment of Carbon Monoxide Poisoning. Dtsch Arztebl Int. 2018;115(51):863-870.

5. Ünsal H, Ertürk Atabey S. Türkiye'de Acil Durum Ve Doğal Afetlerde Sunulan Sağlık Hizmetlerinin Finansmanı. Süleyman Demirel Üniversitesi İktisadi Ve İdari Bilimler Fakültesi Dergisi. 2016; 1(4): 1127-1138.

6. Wu PE, Juurlink DN. Carbon monoxide poisoning. CMAJ. 2014;2 (2);611.

7. Nakajima M, Aso S, Matsui H, Fushimi K, Yamaguchi Y, Yasunaga H. Disaster-related carbon monoxide poisoning after the Great East Japan Earthquake, 2011: a nationwide observational study. Acute Med Surg. 2019;(3):294-300.

8. AccuWeatherAntakyaHatay.https://www.accuweather.com/tr/tr/antakya/317915/februaryweather/317915?year=2023 (Access date: 17.06.2024)

9. Heidari M, Miresmaeeli SS, Eskandary N. Carbon Monoxide Poisoning Post Disaster: Incident After the Incident. Disaster Med Public Health Prep. 2020;14(4):429-430.

10. Tokumaru O, Fujita M, Nagai S, Minamikawa Y, Kumatani J. Medical Problems and Concerns with Temporary Evacuation Shelters after Great Earthquake Disasters in Japan: A Systematic Review. Disaster Med Public Health Prep. 2022;16(4):1645-1652.

11. Li W, Meng J, Lei J, Li C, Yue W. Carbon monoxide poisoning with hippocampi lesions on MRI: cases report and literature review. BMC Neurol. 2024;24(1):159.