Research Article

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Evaluation of Carbon Monoxide Poisonings Observed After the February 6, 2023 Kahramanmaraş Earthquake

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Abstract

Objective: Carbon monoxide poisoning is a significant public health concern that can increase following natural disasters. This study aims to determine the frequency, etiological causes, and clinical characteristics of carbon monoxide poisoning cases presenting to the emergency department in the post-earthquake period following the Kahramanmaraş earthquakes on February 6, 2023.

Materials and Methods: This study includes the demographic and clinical data of patients diagnosed with carbon monoxide poisoning who presented to the emergency department following the earthquake. Patients' age, gender, presenting symptoms, carboxyhemoglobin levels, treatment approaches, and clinical outcomes were recorded. The data were analyzed by comparing the pre-earthquake and post-earthquake periods.

Results: A significant increase in the number of patients presenting to the emergency department due to carbon monoxide poisoning was observed in the post-earthquake period. Most cases were associated with the use of heaters and generators in temporary shelter areas with inadequate ventilation. Clinically, the most common presenting symptoms were headache, dizziness, and altered consciousness. Additionally, the proportion of cases requiring hyperbaric oxygen therapy was found to have significantly increased.

Conclusions: A significant increase in the incidence of carbon monoxide poisoning was observed following the Kahramanmaraş earthquakes. This finding highlights the importance of ensuring safe heating methods and raising public awareness in the post-disaster period. Preventive strategies aimed at reducing carbon monoxide exposure should be developed as part of disaster management.

Keywords: Carbon Monoxide Poisoning, Earthquake, Disaster, Carboxyhemoglobin

Introduction

Carbon monoxide (CO) poisoning remains a significant public health issue worldwide, being a preventable yet potentially severe cause of morbidity and mortality[1]. CO is a colorless, odorless, and tasteless gas, making it difficult to detect. When inhaled, it rapidly binds to hemoglobin, forming carboxyhemoglobin (COHb), which reduces oxygen-carrying capacity, leading to tissue hypoxia and metabolic disturbances. CO poisoning can present with a wide range of clinical manifestations, including headache, dizziness, altered consciousness, as well as cardiovascular and neurological complications, and can be fatal in severe cases[2]. Carbon monoxide (CO) poisoning can lead to clinical findings such as hypothermia, erythematous (red) skin changes, and bullae formation in pressure-sensitive areas. Oxygen is administered as an antidote in treatment[3]. The most common causes of CO exposure include heaters, stoves, water heaters, and generators that operate with incomplete combustion of fossil fuels. The use of these devices, especially in poorly ventilated conditions, can result in CO accumulation, increasing the risk of poisoning. After natural disasters, particularly large-scale catastrophes such as earthquakes, the risk of carbon monoxide (CO) poisoning tends to increase. The primary reasons for this include restricted access to safe heating and energy sources due to infrastructure damage, the use of inappropriate heating systems in temporary shelter areas, and prolonged stays in enclosed spaces. The literature reports a significant rise in CO poisoning cases following the 1999 Marmara Earthquake and the 2011 Japan Earthquake. These events highlight the impact of CO exposure on public health in the aftermath of natural disasters and emphasize the importance of preventive strategies[4,5].

Köseoğlu et al. emphasized that major disasters like earthquakes not only cause traumatic injuries but also lead to significant secondary health issues. Their study highlighted the burden on healthcare systems, particularly due to conditions such as crush syndrome and rhabdomyolysis. Similarly, our study demonstrates a marked increase in carbon monoxide poisoning cases post-earthquake, underscoring the need for a comprehensive approach to post-disaster health risks[6].

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The earthquakes centered in Kahramanmaraş, Turkey, on February 6, 2023, caused widespread destruction and affected millions of people, leading to significant challenges in shelter, heating, and energy supply. In the post-disaster period, thousands of people were forced to live in temporary shelters such as tents and containers, resulting in the widespread use of unsafe heating methods. Following this disaster, which occurred during the winter months, the improper use of stoves, catalytic heaters, and generators in enclosed spaces may have contributed to an increase in carbon monoxide poisoning cases.

This study aims to evaluate the frequency, etiological causes, and clinical characteristics of carbon monoxide poisoning cases in the post-earthquake period following the Kahramanmaraş earthquakes on February 6, 2023. By comparing the pre-earthquake and post-earthquake periods, the study seeks to identify changes in CO exposure. The findings obtained will contribute to the development of public health policies in the aftermath of disasters and the strengthening of strategies to prevent carbon monoxide poisoning.

Materials and Methods

This study was conducted using a retrospective observational design. The study included and compared patients who presented to the Emergency Department of Kahramanmaraş Sütçü İmam University with suspected carbon monoxide poisoning between February 6, 2022 – May 6, 2022, and February 6, 2023 – May 6, 2023.

Ethical Approval:
The study was approved by the Ethics Committee of Kahramanmaraş Sütçü İmam University with the decision dated 25.11.2024 and numbered 2024/31.

Inclusion Criteria:
- Age 18 years or older,
- Presence of symptoms consistent with CO exposure,
- Elevated carboxyhemoglobin (COHb) levels in arterial blood gas analysis.

Exclusion Criteria:
- Incomplete or insufficient medical records,
- Presence of alternative CO exposure sources, such as smoking,
- Low carboxyhemoglobin (COHb) levels in arterial blood gas analysis.

Data Collection:
Demographic information, clinical findings, laboratory results, and vital parameters were retrospectively obtained from the hospital automation system.

Table 1: Clinical and Laboratory Findings of Patients Based on COHb Levels

Parameter	Total Group (n=63)	COHb ≤ 15 (n=24)	COHb > 15 (n=39)	p Value
Age (years)	38,57 ± 14,20	37 ± 13	39 ± 15	0,625
pH	7,37 ± 0,05	7,39 ± 0,04	7,36 ± 0,05	0,043
pO2 (mmHg)	43,81 ± 36,09	59,3 ± 48,5	34,0 ± 20,8	<0,001
SaO2 (%)	94,24 ± 3,92	97 ± 3	93 ± 4	<0,001
Lactate (mmol/L)	2,19 ± 1,27	1,9 ± 1,4	2,4 ± 1,2	0,038
Reaspiratory Rate (breaths/min)	15,24 ± 2,73	14 ± 2	16 ± 3	<0,001
ED Stay (hours)	4,83 ± 1,63	4 ± 1	5 ± 2	0,062

Grouping:
Patients were categorized into two groups based on their COHb levels:
- **Group 1:** COHb ≤15 (n=24)
- **Group 2:** COHb >15 (n=39)

Statistical Analysis:
Data were analyzed using IBM SPSS v.23 software. Continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as percentages (%). Appropriate non-parametric (Mann Whitney U) test were used for comparisons between groups. A p-value of <0.05 was considered statistically significant.

Results

A total of 63 patients were included in the study. Patients were categorized into two groups based on their COHb levels: Group 1 (COHb ≤ 15, n=24) and Group 2 (COHb > 15, n=39). Demographic data, arterial blood gas values, laboratory parameters, and vital signs are summarized in **Table 1**.

The graph presents the number of carbon monoxide poisoning cases in February, March, and April of 2022 and 2023. A significant increase in the number of cases is observed in February, March, and April 2023 compared to the corresponding period in 2022.

A significant increase in carbon monoxide poisoning cases was detected in the post-earthquake period, particularly in February. Additionally, it was observed that the majority of cases occurred during nighttime hours.

Discussion

This study demonstrates a significant increase in carbon monoxide (CO) poisoning cases following the Kahramanmaraş earthquakes on February 6, 2023. Major disasters such as earthquakes not only cause physical destruction but also lead to severe secondary public health

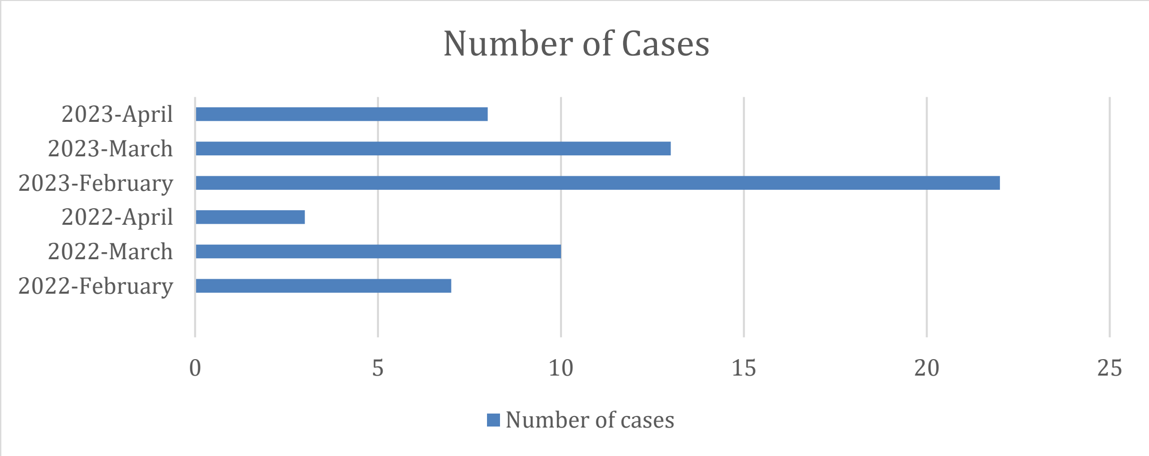

Figure 1: Monthly Distribution of Carbon Monoxide Poisoning Cases

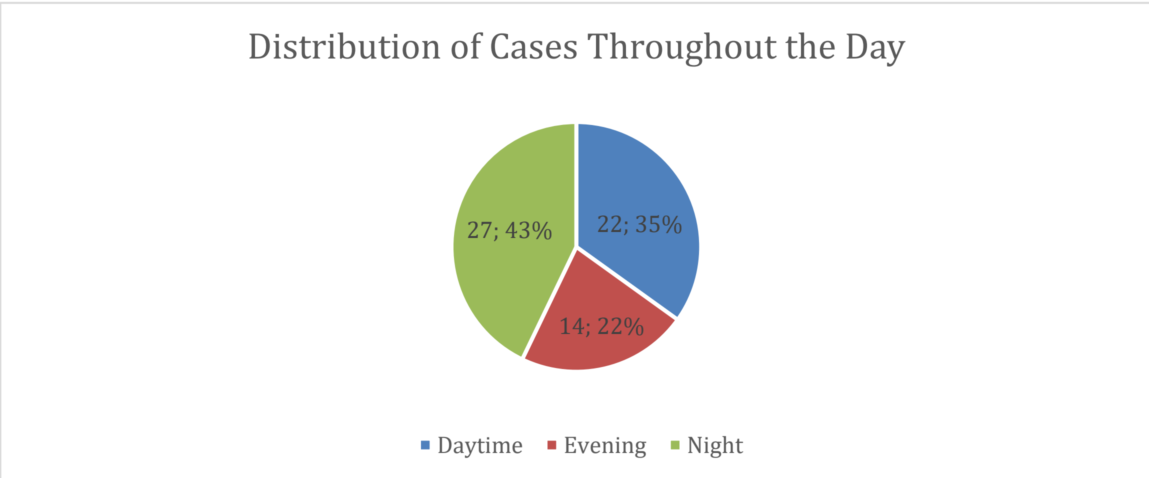

Figure 2: Distribution of Carbon Monoxide Poisoning Cases Throughout the Day. (43% of the cases occurred at night, 35% during the daytime, and 22% in the evening.)

issues1,2. In particular, the increased use of unsafe heating sources in temporary shelter areas has resulted in a notable rise in CO exposure-related poisonings4. Our findings indicate that this increase was especially pronounced during the cold winter months following the disaster and at nighttime. This observation is consistent with previous reports in the literature documenting a rise in CO poisoning cases after various disasters.

Previous research on post-disaster carbon monoxide poisoning has reported similar findings. For instance, a significant increase in CO poisoning cases was documented following the 1999 Marmara Earthquake and the 2011 Japan Earthquake. These studies highlighted that one of the primary risk factors was the use of stoves, charcoal grills, or other fossil fuel-powered devices in enclosed spaces by individuals residing in tents and containers to meet their heating needs after the earthquakes[5,7,8]. Similarly, our study also found that the majority of CO poisoning cases occurred during nighttime hours and that the use of fossil fuels in enclosed spaces was prevalent. Carbon monoxide (CO) is a toxic gas that is difficult to detect due to its colorless, odorless, and tasteless nature. It binds to hemoglobin with high affinity, forming carboxyhemoglobin (COHb), which prevents oxygen transport and leads to tissue hypoxia[9,10].

In our study, significant changes were observed in arterial blood gas parameters in patients with COHb > 15. Specifically, a decrease in pO_2, SaO_2, and pH levels was noted, while lactate levels showed a marked increase. These findings indicate that CO exposure leads to systemic hypoxia and triggers anaerobic metabolism. It is well established in the literature that carbon monoxide poisoning causes hypoxia and lactic acidosis, and the results of our study support this knowledge[11].

Additionally, our study identified a significant increase in respiratory rate associated with COHb levels. This finding suggests that CO exposure triggers a hypoxic respiratory response, indicating that patients compensate for hypoxia through physiological mechanisms. Previous studies have similarly demonstrated that CO exposure can lead to an increased respiratory rate[12]. This physiological response is an important factor in understanding the clinical course of CO poisoning and should be considered as a key parameter in emergency department diagnosis.

The prevention of carbon monoxide poisoning is possible through early diagnosis and appropriate treatment approaches. In mild to moderate cases, high-flow oxygen therapy can reduce the half-life of COHb, while hyperbaric oxygen therapy is recommended for severe cases[13-15]. However, post-disaster conditions should be considered, as access to such treatments may be challenging. Therefore, the implementation of preventive measures is of critical importance. The observed increase in cases in our study further highlights the necessity of educating the public about carbon monoxide poisoning, ensuring safe shelter conditions, and promoting the use of carbon monoxide detectors in the aftermath of disasters.

One of the limitations of our study is its retrospective design. The retrospective collection of data may lead to missing clinical information. Additionally, it should be considered that the actual number of cases may be higher due to the overwhelming patient load. Nevertheless, our study presents valuable findings demonstrating the increased risk of carbon monoxide poisoning following a disaster and may serve as a guide for future research aimed at raising awareness on this issue.

Conclusion

This study demonstrates a significant increase in carbon monoxide poisoning cases following the Kahramanmaraş earthquakes on February 6, 2023. The majority of cases, which occurred particularly during the winter months and nighttime hours, were associated with temporary shelter conditions and the use of unsafe heating methods. Raising public awareness, promoting the widespread use of carbon monoxide detectors, and ensuring safe shelter environments are crucial for preventing CO poisoning in post-disaster periods. Additionally, healthcare professionals should be prepared for carbon monoxide poisoning cases during disaster periods. Future studies should focus on a more detailed assessment of risk factors in this field and the development of effective preventive strategies.

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