*Case Report*

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# Unprecedented Incident of Carbon Monoxide Poisoning in an Outdoor Environment: A Thorough case Analysis and Implications for Safety Protocols

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**Abstract**

Carbon monoxide (CO) poisoning typically occurs in enclosed spaces and often affects groups of people, making it relatively easy to suspect based on the circumstances. However, CO poisoning can also occur in situations where it is not easily anticipated. We encountered a case of CO poisoning that occurred in a non-enclosed space and was initially suspected to be heat stroke. A 60-year-old ferryman exposed to exhaust fumes from a diesel-powered motorboat in a non-enclosed workspace who presented with a generalized seizure, metabolic acidosis, tachycardia, and hypotension. Carboxyhemoglobin (COHb) level was 38.2%, confirming significant CO exposure. Prompt intervention with oxygen therapy and norepinephrine stabilized the patient, with improvement noted over 72 hours and COHb levels decreasing to 4.2%. Follow-up indicated modifications to prevent future exposures. This case highlights the diagnostic challenge of CO poisoning in open environments and underlines the importance of maintaining clinical suspicion despite atypical presentations and the absence of concurrent symptoms in others nearby. Understanding CO's diffusion dynamics and potential for significant exposure even in well-ventilated spaces is crucial for timely diagnosis and management. The findings stress the need for heightened awareness among emergency responders and healthcare providers to promptly recognize and manage CO poisoning in diverse environmental settings, ensuring optimal patient outcomes and minimizing risks to responders.

**Keywords:** Carbon monoxide poisoning; Carboxyhemoglobin.

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## INTRODUCTION

The symptoms of carbon monoxide (CO) poisoning are non-specific, making it possible to confuse them with various other conditions. Thus, diagnosis is often based not only on symptoms but also on the circumstances surrounding the patient.[1] CO poisoning is strongly suspected in cases of intentional suicide, fires, or when multiple household members or pets exhibit similar symptoms.[2] However, when these conditions are not met, it becomes challenging to suspect CO poisoning. Here, we report a case of CO poisoning that occurred in a non-enclosed space where no surrounding workers exhibited any health issues and heat stroke was initially suspected.

## CASE REPORT

A 60-year-old male presented to the emergency room (ER) following a generalized seizure, which occurred 30 minutes prior to arrival while he was working as a ferryman. The seizure, lasting 2 minutes and accompanied by bowel and bladder incontinence, was witnessed by his co-worker who transported him to the ER. Postictal confusion persisted for 15 minutes, followed by drowsiness. The patient, a known case of well-controlled type 2 diabetes managed with oral hypoglycemic agents, had no previous history of seizures.

Upon arrival, his airway was patent, with a respiratory rate of 22 cycles per minute, and he was maintaining an oxygen saturation of 82% on room air. Auscultation revealed no additional sounds. He presented with cold peripheries, tachycardia (heart rate of 120 beats per minute), and hypotension (blood pressure of 80/60 mmHg). His Glasgow Coma Scale (GCS) score was E3V3M5 on arrival. Bilateral pupils were 2 mm and reactive to light. There was no neck stiffness, focal neurological deficits, pallor, or jaundice observed. Notably, the patient's skin was red, moist, and covered in profuse sweat.

Arterial blood gas analysis revealed high anion gap metabolic acidosis with compensatory mechanisms. Electrocardiography indicated sinus tachycardia, while his chest X-ray appeared normal. The patient was administered oxygen via a non-rebreather mask (NRBM) at a flow rate of 15 liters per minute. Intravenous infusion of one liter of normal saline was initiated; however, when there was no improvement in blood pressure, a norepinephrine infusion was started at a rate of 0.05 mcg/kg/min, resulting in an improved blood pressure of 100/70 mmHg.

During the secondary survey, a detailed history revealed that the patient was a ferryman who had been operating a new diesel-powered motorboat. The exhaust was situated near the driver's seat, and he had complained about the exhaust smoke being in close proximity to the driver. He experienced these issues while testing the new boat. Additionally, his friend, who had accompanied him on several rides, also reported experiencing headaches.

A high index of suspicion for carbon monoxide (CO) poisoning and heat stroke was raised as differential diagnosis. Carboxyhemoglobin (COHb) levels were measured and found to be 38.2%, confirming significant CO exposure. This was likely due to close proximity of exhaust fumes to the driver.

The patient's electrolytes and renal function were within normal limits, and magnetic resonance imaging (MRI) of the brain was normal. Oxygen therapy via a NRBM was continued, and the patient was transferred to the critical care unit for further monitoring. After 16 hours of admission, the patient's GCS score began to improve. At 48 hours, the COHb level had decreased to 17.3%, and the patient's GCS improved to E4V4M5. He was then transferred to the ward with continued NRBM oxygen therapy.

By 72 hours post-admission, the patient was asymptomatic, with COHb levels reduced to 4.2%, allowing discontinuation of oxygen therapy. He was counseled on work ergonomics to prevent future incidents.

At a two-week follow-up, the patient remained asymptomatic. He reported that the boat's exhaust system had been modified to direct fumes away from the driver and passengers to an open space, effectively preventing further CO exposure.

## DISCUSSION

In many instances, carbon monoxide (CO) poisoning is typically suspected in enclosed spaces.[3] However, as evidenced by this case, CO poisoning can occur in open environments where there may be few reports of health issues among those nearby. Therefore, it is imperative for emergency responders and physicians to maintain a high level of awareness regarding the potential for CO poisoning in such scenarios.

The diagnosis of CO poisoning hinges on gathering a detailed history of exposure, identifying presenting symptoms, and detecting elevated levels of COHb in the blood.[4] Given the nonspecific nature of symptoms, a heightened clinical suspicion is crucial for accurate diagnosis, although definitive confirmation requires measurement of CO concentrations in the blood.[5]

CO poisoning can be secondary to various sources such as fires, incomplete combustion of household fuels, vehicle exhausts, or pipeline leaks, leading to inhalation of this toxic gas.[6] The level of COHb saturation in the body correlates with the concentration of CO in the environment, duration of exposure, respiratory rate, and other factors. Higher CO concentrations and prolonged exposure in poorly ventilated areas heighten the risk of poisoning. Symptoms in multiple individuals or pets within the same space are indicative of CO exposure.[7]

In this case study, the incident occurred in a gas-handling workspace, initially prompting

concerns of CO exposure. However, due to the non-enclosed nature of the area, the high ambient temperature, and significant patient sweating, a heat stroke can be a differential diagnosis along with CO poisoning.[8] Subsequent investigation revealed a CO leak from corroded packing material in nearby pipes, confirming the diagnosis. Arterial blood gas analysis conducted approximately one hour post-symptom onset showed a COHb level of 34.5%, substantiating the diagnosis of CO poisoning.

CO, being a gas that tends to diffuse upwards, coupled with the incident's occurrence in a non-enclosed environment, likely contributed to the absence of worker complaints from lower levels. While CO poisoning in well-ventilated open spaces is uncommonly fatal, a few outdoor incidents near CO sources have been reported. Thus, it is imperative to acknowledge the potential for CO poisoning in environments where CO may be present, irrespective of space size, ventilation quality, or absence of evident symptoms.[9] This recognition is crucial for prompt treatment patient and safeguarding emergency responders from secondary harm.[10]

## CONCLUSION

Carbon monoxide poisoning is typically suspected in enclosed spaces where multiple individuals are affected. However, it is essential for emergency responders and physicians to acknowledge that CO poisoning can also occur in non-enclosed open spaces without concurrent reports of similar symptoms among others nearby, complicating the diagnostic process. This underscores the importance of maintaining a high index of suspicion for CO poisoning in diverse environmental settings, ensuring timely recognition and appropriate management to mitigate potential harm.

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