

## CLINICAL VIGNETTE

# Chronic Carbon Monoxide Exposure: A Case Report

Lindsay K. Wells, M.D.

### *Case Presentation*

A 30-year-old male presented to the office with multiple vague complaints including dizziness and vomiting (non-bloody, non-bilious) for three months. The patient had a multiply positive review of systems including generalized weakness and fatigue, an episode of loss of consciousness, intermittent blurry vision, as well as shortness of breath and chest tightness both at rest and with exertion. Other symptoms included night sweats, abdominal pain that did not change with food intake, daily headaches, anxiety, insomnia, poor concentration, and short-term memory impairment. The patient denied weight loss, and no focal neurological changes. He presented in the spring and noted that all these symptoms had persisted for several months. His complaints were worse at night and in the morning and improved when the patient was away from his home. The patient had no prior medical problems and denied smoking, alcohol, or illicit drug use. The patient denied any environmental exposures at work, but noted that his carbon monoxide detector at his home would occasionally alarm.

Further review of the patient's medical history revealed that during the first month of his symptoms, the patient had a syncope episode while working on a ladder at his job. The event was witnessed by colleagues and was described as lasting only a few seconds. Seizure activity was not observed. Because of the fall from the ladder and possible resulting head trauma, the patient was acutely evaluated at a local emergency department. He was discharged from the ER with the diagnosis of a post-concussion syndrome after a normal head and cervical spine CT. Following discharge from the ER, because of the persistence of symptoms, the patient was re-evaluated at an urgent care office and by an ophthalmologist. He was treated with tramadol, lorazepam, and metoclopramide and told his symptoms were likely secondary to a combination of his concussion and anxiety.

Our examination revealed a fit-looking young man and was fairly unremarkable. Vital signs were within normal limits except for an elevated blood pressure of 155/99. An arterial blood gas was remarkable for a low pO<sub>2</sub> of 84 mmHg (reference range 98-118 mmHg) and a mildly elevated CO<sub>2</sub> of 30 (reference range 20-29) on his basic electrolyte panel. His carboxyhemoglobin and methemoglobin levels on the arterial blood gas w/ co-oximetry were within normal limits.

Additionally, labs including liver function tests, creatinine, and glucose were within normal limits.

Given the patient's history of the chronic vague, non-specific symptoms, subtle lab findings, and reports of his CO detector alarming, there were concerns for chronic mild carbon monoxide exposure. The patient was advised to have his apartment inspected for CO levels and to remove himself from the likely source of carbon monoxide: his apartment. After being physically removed from his apartment for approximately seventy-two hours, his symptoms had significantly improved, but he still noted difficulty with concentration. The patient's apartment wall heater was replaced after it was determined to be leaking mildly elevated levels of carbon monoxide.

### *Discussion*

Carbon monoxide (CO) is a colorless, odorless, and tasteless gas that is slightly lighter than air. It is toxic to humans and animals when encountered in higher concentrations, although it is also produced in low quantities with normal animal metabolism and is thought to have some normal biological functions. For example, in the atmosphere, it has a role in the formation of ground-level ozone.<sup>1</sup>

Unintentional, non-fire-related carbon monoxide poisoning is one of the most common causes of poisoning in the United States. It results in more than 20,000 emergency room visits annually.<sup>2</sup> It is most common during the winter months especially in cold climates. Smoke inhalation contributes to a majority of cases of CO poisoning. Other potential sources of CO include heating systems, fuel burning devices, and motor vehicles. Carbon monoxide is toxic to humans and animals when encountered in higher concentrations. It combines with hemoglobin to produce carboxyhemoglobin (COHb), which displaces the space in hemoglobin that normally carries oxygen and makes hemoglobin ineffective for delivering oxygen to bodily tissues.

Although acute CO poisoning is well-documented, chronic CO poisoning is less understood.<sup>3,4</sup> The most common symptoms of chronic carbon monoxide poisoning are vague. They include headache, nausea, vomiting, dizziness, fatigue, and a feeling of weakness.<sup>3</sup> Due to these non-specific symptoms, chronic carbon monoxide exposure is often misdiagnosed as a flu-like

viral illness or neurologic disorders such as migraines.<sup>5,6</sup> Neurological signs include confusion, disorientation, visual disturbance, syncope, and seizures. Psychiatric symptoms such as anxiety, depression, and personality changes have also been described.<sup>7</sup>

Carbon monoxide concentrations of 667 ppm can cause up to 50% of the body's hemoglobin to convert to carboxyhemoglobin.<sup>8</sup> Normal human COHb levels are less than 2%. COHb levels of 5-13% are normal levels found in tobacco smokers, but even these levels can cause symptoms in those with ischemic heart disease.<sup>1,7</sup> COHb levels of 15-20% can cause mild headaches. Levels of 15-20% results in severe headaches, dizziness, nausea, fatigue, and impaired hand dexterity. A level of 50% (COHb) may result in seizure or coma, and, if levels are higher, fatality. In the US, the OSHA limits long-term workplace exposure (average over an 8 hour work period) to levels below 50 ppm which would correspond to a COHb percentage of less than 10%.<sup>1,9</sup>

Laboratory data are limited in establishing a diagnosis. A normal co-oximetry test does not exclude the diagnosis of chronic carbon monoxide exposure since testing typically occurs several hours after removal from the carbon monoxide exposure. Since the half-life of CO is approximately 5 hours, typically the COHb returns to normal levels within a few hours of exposure to fresh air.<sup>7,10</sup> Typically, the patient's medical history including environmental exposures is the key piece to correctly identifying the diagnosis of chronic carbon monoxide poisoning.<sup>6</sup>

### Conclusion

Although acute carbon monoxide poisoning is well recognized, less is known about chronic CO monoxide exposure. The diagnosis of chronic carbon monoxide poisoning is challenging due to a vague and non-specific clinical presentation coupled with a typically normal physical exam and labs. These patients are often misdiagnosed and thus fail to be removed from their inciting environmental exposure. Obtaining a thorough environmental history is extremely important in establishing the diagnosis of chronic carbon monoxide exposure.

### REFERENCES

1. **Bleecker ML.** Carbon monoxide intoxication. *Handb Clin Neurol.* 2015;131:191-203. doi: 10.1016/B978-0-444-62627-1.00024-X. PubMed PMID: 26563790.
2. **Centers for Disease Control and Prevention (CDC).** Nonfatal, unintentional, non--fire-related carbon monoxide exposures--United States, 2004-2006. *MMWR Morb Mortal Wkly Rep.* 2008 Aug 22;57(33):896-9. PubMed PMID: 18716581.
3. **Kirkpatrick JN.** Occult carbon monoxide poisoning. *West J Med.* 1987 Jan;146(1):52-6. PubMed PMID: 3825110; PubMed Central PMCID: PMC1307181.
4. **Wright J.** Chronic and occult carbon monoxide poisoning: we don't know what we're missing. *Emerg Med*

- J.* 2002 Sep;19(5):386-90. PubMed PMID: 12204981; PubMed Central PMCID: PMC1725950.
5. **Heckerling PS.** Occult carbon monoxide poisoning: a cause of winter headache. *Am J Emerg Med.* 1987 May;5(3):201-4. PubMed PMID: 3580051.
6. **Kanburoglu MK, Cizmeci MN, Akelma AZ.** A Rare Cause of Chronic Headache that May Be Misdiagnosed as Migraine: Chronic Carbon Monoxide Poisoning. *Turk J Emerg Med.* 2016 Feb 26;14(3):132-4. doi: 10.5505/1304.7361.2014.00868. eCollection 2014 Sep. PubMed PMID: 27331183; PubMed Central PMCID: PMC4909948.
7. **Nakamura T, Setsu K, Takahashi T, Miyashita M, Sugiyama N, Washizuka S, Murata S, Hanihara T, Amano N.** Chronic exposure to carbon monoxide in two elderly patients using a kotatsu, a traditional Japanese charcoal-based heater. *Psychogeriatrics.* 2015 Nov 9. doi: 10.1111/psyg.12164. [Epub ahead of print] PubMed PMID: 26551791.
8. **Tikusis P, Kane DM, McLellan TM, Buick F, Fairburn SM.** Rate of formation of carboxyhemoglobin in exercising humans exposed to carbon monoxide. *J Appl Physiol* (1985). 1992 Apr;72(4):1311-9. PubMed PMID: 1592720.
9. **OSHA Fact Sheet: Carbon Monoxide.** United States National Institute for Occupational Safety and Health Website. [https://www.osha.gov/OshDoc/data\\_General\\_Facts/carbomonoxide-factsheet.pdf](https://www.osha.gov/OshDoc/data_General_Facts/carbomonoxide-factsheet.pdf). Published 2002. Accessed August 17, 2016.
10. **Myers RA, Linberg SE, Cowley RA.** Carbon monoxide poisoning: the injury and its treatment. *JACEP.* 1979 Nov;8(11):479-84. Review. PubMed PMID: 388013.

Submitted August 17, 2016