May 4th, 12:00 AM

Case Report: Carbon Monoxide Poisoning: A Sleuth

Joel Collins
Rowan University

Wayne Tamaska
Jefferson Health

Anna Barton
Morristown Memorial Hospital, Morristown, NJ

James Espinosa
Rowan University

Alan Lucerna
Rowan University

Case Report: Carbon Monoxide Poisoning: A Sleuth

Joel Collins II MD[1], Wayne Tamaska DO[1], Anna Barton MD[2] James Espinosa MD[1], Alan Lucerna DO[1]

[1]Emergency Medicine Residency and Department of Emergency Medicine, Jefferson Health New Jersey
[2]Department of Department of Pediatric Medicine, Morristown Memorial Hospital, Morristown, NJ

Abstract:

We report a case of a 18 year old male who presented via EMS who was called for an unconscious male in his car diagnosed initially with opioid overdose and later found to have carbon monoxide poisoning. The differential diagnosis of carbon monoxide poisoning is someone broad and non specific, but in general, carbon monoxide poisoning can be initially elusive in diagnosis and requires continued consideration. This remains true especially in this case of an unconscious male with initial responsiveness to naloxone. It is predictable that as with time the preponderance and relative commonality of this condition will decrease with the further developments in renewable energy especially in the realm of electric cars. However, we also must recognize the long term effects of carbon monoxide poisoning and the importance of early recognition by emergency physician, and the decision to treat or not to treat with hyperbaric medicine.

Case Presentation:

18 yr old male with past medical history of marijuana use presented to the emergency department after EMS received call for an unconscious vomiting male inside his car at a local petrol station. On arrival EMS reported administration of naloxone with subsequent responsiveness. EMS further reported patient was in his car covered in his own vomit and unconscious on initial scene surveillance.
Given his responsiveness to naloxone the assumed diagnosis was drug overdose which he adamantly denied stating he simply fell asleep waiting for a friend. Lactate and troponins were drawn along with a rainbow of labs many of which were abnormally elevated.
Mentation was appropriate throughout emergency department stay and workup was further expanded. He was promptly treated with high flow oxygen administration.
Patient was found to have carboxyhemoglobin poisoning with associated elevated troponins and lactate. Discussion with hyperbaric medicine specialist stated due to continued improved mentation he could be managed further by hospital admission and trending of labs. Also considering the age of the patient and improving status that transfer was unnecessary.
[CO2 on BMP 13 mmol/L, gap of 21 mmol/L, Lactate of 12.7 mmol/L, initial troponin 144 ng/L, second troponin 463 ng/L, third 909 ng/L, CPK 346, VBG 7.29, pCO2 42, Bicarb 20 mmol/L, Carboxyhemoglobin 15.8% (high), oxyhemoglobin 82.7% (low) base excess -3.9, UDS positive for cannabis only, negative head ct and chest xray, incidentally influenza A positive].

Discussion:

Most literature agrees that in the setting of loss of consciousness, neurological deficits, changes in mental status, in the setting of pregnancy, end organ ischemia including EKG changes or pH less than 7.1, or carboxyhemoglobin of 20% or greater that hyperbaric oxygen therapy is indicated per Bubuoltz. Although discussion with a hyperbaric medicine specialist took place, it was agreed upon that due to the patient's age and stability he did not require transfer for hyperbaric therapy. Although loss of consciousness did occur he regained consciousness and maintained his mentation throughout his visit in the emergency room. This patient also did not have ongoing chest pain or EKG changes although he was spilling troponins. Decisions for the use of hyperbaric medicine treatment in carbon monoxide poisoning is most often complex. Carbon monoxide poisoning requires swift recognition by emergency physicians of this elusive diagnosis, as well as multi-dimensional analysis from specialist counterparts in the field of hyperbaric medicine.

Rose et al states that hyperbaric therapy shows it's benefits in reducing long term neurological sequela but not survival. It is hypothesized that due to the age of the patient's vehicle, that there was a leak somewhere in the frame of his vehicle. As the vehicle continued to idle carbon monoxide built up to points of intoxication causing the patient to pass out and ultimately vomit.

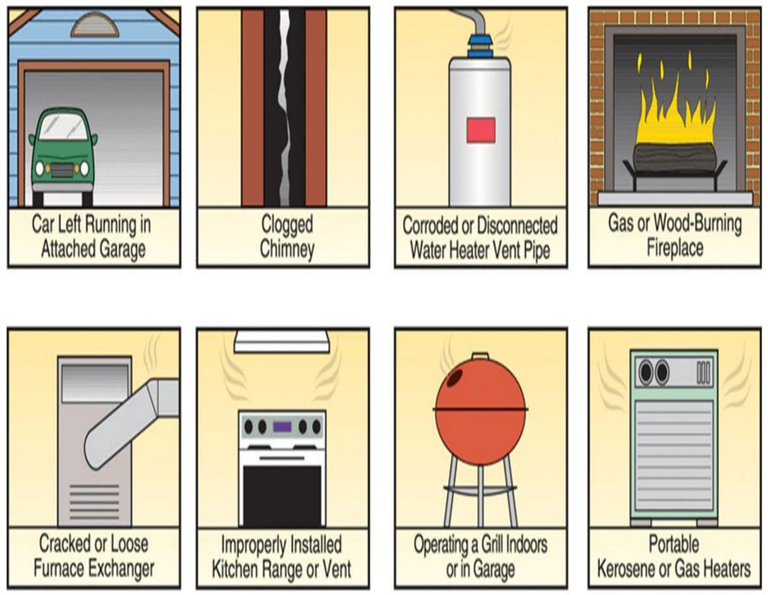

Figure 1:Some carbon monoxide sources. (bing.com)

References:

1. Buboltz JB, Robins M. Hyperbaric Treatment Of Carbon Monoxide Toxicity. [Updated 2022 May 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470531/
2. Rose JJ, Nouraie M, Gauthier MC, Pizon AF, Saul MI, Donahoe MP, Gladwin MT. Clinical Outcomes and Mortality Impact of Hyperbaric Oxygen Therapy in Patients With Carbon Monoxide Poisoning. Crit Care Med. 2018 Jul;46(7):e649-e655. doi: 10.1097/CCM.0000000000003135. PMID: 29629990; PMCID: PMC6005724.
3. Weaver LK, Hopkins RO, Chan KJ, et al. Hyperbaric Oxygen for Acute Carbon Monoxide Poisoning. *N Engl J Med*. 2002;347(14):1057-1067. doi:10.1056/NEJMoa013121
4. Huang CC, Ho CH, Chen YC, Hsu CC, Wang YF, Lin HJ, Wang JJ, Guo HR. Impact of Hyperbaric Oxygen Therapy on Subsequent Neurological Sequelae Following Carbon Monoxide Poisoning. J Clin Med. 2018 Oct 13;7(10):349. doi: 10.3390/jcm7100349. PMID: 30322113; PMCID: PMC6211110.
5. Wolf SJ, Maloney GE, Shih RD, Shy BD, Brown MD. Clinical policy: critical issues in the evaluation and management of adult patients presenting to the emergency department with acute carbon monoxide poisoning. *Ann Emerg Med.* 2017;69:98–107.
6. Eichhorn L, Thudium M, Jüttner B. The Diagnosis and Treatment of Carbon Monoxide Poisoning. Dtsch Arztebl Int. 2018 Dec 24;115(51-52):863-870. doi: 10.3238/arztebl.2018.0863. PMID: 30765023; PMCID: PMC6381775.

Discussion:

Long term sequela of carbon monoxide poisoning can include multiple cognitive dysfunctions including decreased concentration, memory difficulty, depression, and more. Weaver et al states that cognitive sequelae were reduced in approximately 45% of patients in their study that required hyperbaric therapy. Huang et al showed incidence rates of degenerative CNS diseases, psychiatric diseases, and other disease of the central nervous system were 23.3, 87.8, and 57.6 per 1000 people in patients receiving hyperbaric oxygen therapy. Respectively those without treatment experienced 14.9, 59.3, and 34.9 per 1000 people. The importance of this study hallmarks the importance of hyperbaric oxygen therapy in reduction of long-term neurological sequela at the 6 and 12 month treatment and brings to light the importance of treatment especially in the presence of multiple medical comorbidities.

Incidence of Carbon Monoxide Poisoning:
Buboltz et al states that there are approximately 40,000 emergency department visits per year and 6000 deaths per year of carbon monoxide poisoning in the US alone. Buboltz goes on to state that most deaths are often intentional and brings to light importance of working in well ventilated areas when using combustion engines, using respirators when using hazardous deemed chemicals, and proper personal protective equipment.

Pathophysiology:
The pathophysiology of carbon monoxide poisoning begins at the cellular level where displacement of oxygen from hemoglobin occurs. The affinity of carbon monoxide is nearly 250 times stronger than that of oxygen. Main toxic effects include a generalized hypoxia throughout the body however specific organs most often affected include the heart and brain due to the impaired functions of NADPH oxidase and oxidative phosphorylation. Symptoms include but are not limited to headache, fatigue, nausea, shortness of breath, and impaired cognition. The importance of use of high flow oxygen is highlighted due to the need to oversaturate hemoglobin molecules and decrease affinity of carbon monoxide effectively improving symptoms.
Presentation Carbon Monoxide Poisoning:
Carbon monoxide poisoning can be extremely elusive therefore the importance of a broad differential with all patients is important. Presentation may show loss of consciousness, altered mental status, flushing of the extremities. Differentials that may present similar include diabetic ketoacidosis, meningitis, encephalitis, hypoglycemia, drug overdose, and arrhythmia.

Laboratory studies:
Laboratory results may aid in diagnosis but are all non- specific until an abg or carboxyhemoglobin level is obtained. Troponins, lactate, and other basic labs may put together a more wholesome picture when used in combination with physical examination.

Imaging:
In the specific case of an unconscious individual, suspected aspiration, hypoxia or cases where emesis is involved it is important to at a minimum obtain ap and lateral films.
Management:
Initial management when there is suspected carbon monoxide poisoning include high flow oxygen therapy. Second considerations include whether the patient will require hyperbaric oxygen therapy and potential transfer to the closest facility with hyperbaric medicine within the first 6 hours and not after 24.

Conclusions:

The differential diagnoses to be considered include but are not limited to diabetic ketoacidosis, meningitis, encephalitis, hypoglycemia, drug overdose, and arrhythmia. Although many differentials are assumed ruled in/out based on responsiveness to interventions such as naloxone, it is of paramount importance we continue to rule out all life-threatening emergencies in the emergency department with thorough workups and absent biases. Eichorn et al states that decision for hyperbaric oxygen therapy should be made in cases of severe intoxication deemed as carbon monoxide level greater than 20, impaired level of consciousness, cardiac ischemia, pregnant patients, or severe neurological deficiencies.