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October 2022 Critical Care Case of the Month: A Middle-Aged Couple “Not Acting Right”

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History of Present Illness

A 62-year-old man and his 61-year-old wife were brought to Emergency Department by family who reported “they’re not acting right”. Both complain of headache, weakness, tiredness, trouble with daily activities and memory difficulties.

PMH, SH, and FH

- They live in a log cabin in a rural area near Payson.
- The man had a history of myocardial infarction and was post-op percutaneous intervention with stenting 3 years ago.
- There was no significant PMH in the woman.
- Both are retired. Neither drank alcohol to excess or smoked.

Meds (man only):

- Enteric-coated aspirin
- Metoprolol
- Atorvastatin

Physical Examination

- Vital signs in both are normal
- Both are oriented X 3 but sluggish and slow to answer.
- Physical examination is otherwise unremarkable in both.

What should be done at this time?

1. CBC, BMP, ABGs
2. CXR
3. EKG
4. 1 and 3
5. All of the above

Correct!

5. All of the above

What is the cause of the confusion of these two patients is unclear. Therefore, a general workup is begun. The results are below:

- Labs: CBC, BMP, ABGs within normal limits
- CXR: mild pulmonary edema in man
- EKG: old Q’s inferiorly in the man, within normal limits in the woman.

In addition, CT’s of the head were performed which showed no acute intracranial abnormalities in both. A urine drug screen was sent in both.

What should be done at this time?

1. Begin oxygen at 100% by mask
2. Initiate therapy with sodium bicarbonate
3. Consult a nephrologist for hemodialysis initiation
4. Give flumazenil in repeated doses
5. Give naloxone, to a maximum of 10 mg

Correct!

1. Begin oxygen at 100% by mask

If you said ask if the SaO₂ is calculated or measured, you are probably even more correct. The SaO₂ was calculated from the PaO₂, PaCO₂ and the pH. When measured directly the SaO₂ was noted to be 75% in the woman and 79% in man.

There are a couple of clues to the source of the patients' confusion. The patients were brought in together which suggested a common source for the changes noted by the family. An extremely likely source for the confusion is poisoning, in this case by carbon monoxide (CO) (1). The source of the CO poisoning was later discovered to be a faulty space heater which they had been using to save money.

Which of the following is the ***most important mechanism*** by which CO lead to hypoxia?

1. CO binding to cytochrome oxidase
2. Lipid peroxygenation
3. Reperfusion injury
4. Shift of the oxygen dissociation curve to the right
5. Shift of the oxygen dissociation curve to the left

Correct!

5. Shift of the oxygen dissociation curve to the left

The normal PaO₂ is about 95 and the normal venous partial pressure of oxygen, PvO₂, is about 40. If you look at the at these pressures in figure 1 you can see that the difference in oxygen saturation, and therefore, the amount of oxygen delivered is much less when the oxygen dissociation curve is shifted to the left.

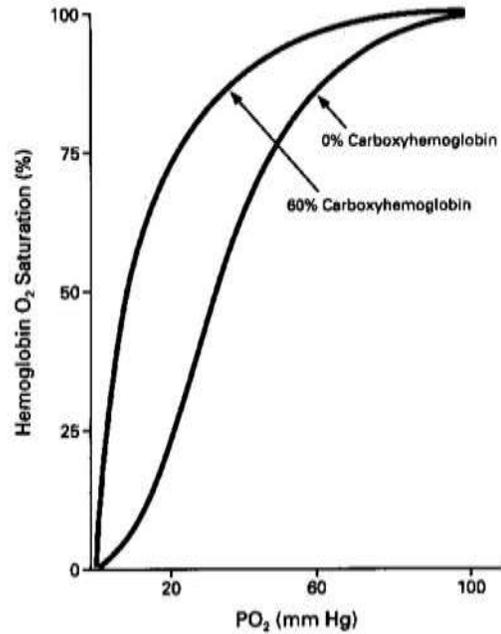


Figure 1. Oxygen dissociation curve with no carboxyhemoglobin and 60% carboxyhemoglobin.

The shift to the left occurs because when only one of the four binding sites for oxygen on hemoglobin is occupied by CO there is a conformational change in the hemoglobin molecule making it more difficult for the remaining 3 oxygen binding sites to release oxygen. All the other mechanisms do occur but most experts favor the left shift of the oxyhemoglobin dissociation curve as the major mechanism lead to hypoxia.

Which of the following are ***true*** regarding CO poisoning?

1. Confusion is nearly always present
2. The SaO₂ is usually decreased
3. The skin is usually a “cherry red” color
4. 1 and 3
5. All of the above

Correct!

2. The SaO₂ is usually decreased

The symptoms of CO poisoning are nonspecific. Table 1 lists some of the most common symptoms of CO poisoning.

Table 1. Most common symptoms of CO poisoning from 8 case series (2).

- Headache
- Dizziness
- Weakness
- Nausea
- Difficulty Conc./Confusion
- Shortness Of Breath

CO poisoning should lower SaO₂, however, it does not necessarily lower the PaO₂.

Physical exam signs of CO poisoning are generally nonspecific (2). The “classic” findings of cherry-red lips, skin, and mucus membranes is very rare (2).

Which of the following are true regarding treatment of CO poisoning?

1. All patients should receive hyperbaric oxygen to prevent the delayed neuropsychiatric syndrome.
2. High-flow 100% FiO₂ continued until carboxyhemoglobin levels have normalized.
3. Pulse oximetry accurately measures SpO₂ and if normal, eliminates the diagnosis of CO poisoning.
4. 1 and 3
5. All of the above

Correct!

2. High-flow 100% FiO₂ continued until carboxyhemoglobin levels have normalized.

Patients with significant CO poisoning should receive high-flow oxygen (2,3). Elimination of carbon monoxide is related to minute ventilation, duration of exposure to O₂, and FiO₂. The Half-life of HbCO is 4 to 6 hours breathing room air, 40 to 80 minutes breathing 100% O₂ and 15 to 30 minutes breathing hyperbaric O₂. Although pulse oximeters have improved, early models were notoriously inaccurate at measuring carboxyhemoglobin (3). The efficacy of hyperbaric oxygen is unclear. The delayed neuropsychiatric syndrome included a broad variety of symptoms after carbon monoxide exposure including cognitive defects,

personality changes, psychic akinesia, parkinsonism, psychotic encephalopathy, amnesia, incontinence, gait disturbances, etc.

91% Some advocated hyperbaric oxygen to prevent this syndrome but data have shown 77% hyperbaric oxygen to be no more effective 53% than 100% FiO₂ (2,3).

47% Which of the following represent a special situation where hyperbaric oxygen should be used if available?

1. Elderly patients
2. Epilepsy
3. Obese patients
4. Pregnancy
5. Young children

Correct!

4. Pregnancy

The authors of UpToDate recommend hyperbaric oxygen in the following situations (3):

- COHb level >25 percent
- COHb level >15 percent in a pregnant patient
- Loss of consciousness
- Severe metabolic acidosis (pH <7.25)
- Evidence of end-organ ischemia (e.g., ECG changes, elevated cardiac biomarkers, respiratory failure, focal neurologic deficit, or altered mental status)

The threshold to use hyperbaric oxygen in pregnant patients is lower because of the greater affinity and longer half-life of CO bound to fetal hemoglobin, the inability to substantially increase placental perfusion, and the direct effects of hypoxemia and acidosis on the fetus (3). Experience is limited but severe maternal poisoning resulted in adverse outcomes in three of five pregnant patients treated with normobaric oxygen alone. Hyperbaric oxygen was used in two other cases, and those children did not demonstrate evidence of prenatal injury (3).

References

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