

Title: Prevention of Carbon Monoxide Poisoning in Dogs

Carbon monoxide is a deadly, odorless, and colorless gas. In humans, overexposure to this poisonous gas is known to cause flu-like symptoms, confusion, memory loss, and death in severe cases. Like humans, dogs experience CO toxicity and share many of the same defining symptoms of poisoning. For our pets, however, the signs of CO poisoning can be more difficult to diagnose. Because of this disparity, it is crucial for pet owners to monitor their pets exposure to CO, especially if their pet has pulmonary issues, cardiovascular issues, or is pregnant.

What is the source of carbon monoxide and why is it deadly to vertebrate species?

In today's age, we heavily rely on the use of non-renewable carbon-based fuels to power our daily activities. In order to utilize this energy source, we use the method of combustion. However, when carbon-based fuels are combusted, this reaction yields carbon monoxide as a byproduct. Some common sources of CO include motorized vehicles, natural gas, propane heaters and stoves, gas powered generators, and dirty chimneys. Though most people use these CO sources daily without incident, these tools can quickly become deadly if they're used in areas with improper ventilation and airflow.

Proper ventilation is a key factor to preventing CO poisoning because of the chemical interaction between CO and hemoglobin in our blood. When we inhale CO from the atmosphere, the oxygen atoms contained in atmospheric oxygen gas (O₂) and the oxygen atoms contained in CO gas compete with each other for a spot on the oxygen-binding sites of hemoglobin molecules. The hemoglobin then circulates through the blood in our circulatory system to deliver oxygen atoms to our organs and tissues. However, CO molecules bind more tightly to hemoglobin than O₂ molecules do, which renders hemoglobin unable to release CO molecules from its binding sites like it releases O₂. In this way, CO effectively blocks O₂ from binding to hemoglobin and prevents the circulation and release of oxygen that is vital for vertebrate species to function.

What are the symptoms of carbon monoxide poisoning in dogs?

As mentioned above, carbon monoxide inhalation limits the amount of oxygen that circulates in the blood and tissues of an animal. In other words, CO poisoning causes varying degrees of hypoxemia; the severity of this affliction depends on the concentration, duration, and frequency of exposure to CO gas. Exposures at concentrations between 10-99 ppm of CO gas in an unventilated space can be dangerous but still treatable at low frequencies and durations between 1-4 hours. However, if the atmospheric concentration of CO gas reaches 100 ppm or greater, toxicity symptoms will be acute and increasingly deadly. In mild cases of exposure, a dog may display lethargy, weakness, and/or nausea. If the concentration and duration of exposure to CO gas increases, dogs will exhibit uncoordinated movement, seizures, deafness, and ultimately death. If your pet has preexisting cardiovascular or pulmonary conditions, the onset and intensity of CO poisoning symptoms may increase because the heart and lungs are the first two organs to experience hypoxia from CO gas exposure.

Moreover, dog breeders should take special notice of CO exposure in pregnant animals because the symptoms of CO poisoning can be two times as lethal to a fetus as they are to its mother. A fetus relies on its mother's blood supply for oxygen, which diffuses across the placenta to bind to fetal hemoglobin. However, CO molecules will also diffuse across the placenta and compete with O₂ molecules for fetal hemoglobin binding sites. The binding of fetal hemoglobin and CO molecules is extremely lethal because fetal hemoglobin has a much larger attraction to oxygen atoms than adult hemoglobin does. The fetal hemoglobin will latch onto CO molecules much quicker than the mother's

hemoglobin will, which means the fetus will show signs of CO poisoning much sooner than the mother. Unfortunately, this often results in an abortion of the fetus without any recognizable causes to the breeder.

Treatment and prevention of carbon monoxide poisoning

In the case of a mild CO gas exposure, treatment includes removing the afflicted animal to fresh atmospheric air or applying an oxygen mask with pure O₂ gas. Depending on the intensity of the exposure, the animal will have to receive these treatments for varying amounts of time. If the animal experiences an extreme exposure to CO gas, the recommended treatment is placing the animal in a hyperbaric chamber, which is a pressurized chamber with air comprised of pure oxygen gas.

While it is very important to know the causes, symptoms, and treatments for CO poisoning, the most important factor is prevention. CO gas detectors are a great way to prevent poisoning. It is best to place your CO detectors lower to the ground because CO gas is slightly denser than the atmosphere and will hang lower to the ground. Placing your detectors closer to the ground is also a good way to monitor your pets' exposure to toxic gases. Furthermore, if you're transporting pets in a motor vehicle, it is a good idea to keep a CO detector in the vehicle because issues with exhaust fumes in cars and trucks are very common.