

Carbon Monoxide Poisoning

Carbon monoxide is invisible and grabs onto hemoglobin (the part of blood that carries oxygen) 200 times tighter than oxygen does. We give oxygen right away and use special high-pressure oxygen chambers for severe cases.

THE ONE-LINE TRUTH

Carbon monoxide sticks to hemoglobin 200 times tighter than oxygen does, so your blood cannot deliver oxygen to your cells.

The chain — how it unfolds

1. Carbon monoxide enters the body (inhaled from fire, exhaust, faulty heater, generator). — why: CO is colorless, odorless, and tasteless, so you breathe it without knowing. It crosses from lungs into blood instantly.
2. Carbon monoxide binds hemoglobin 200 times tighter than oxygen, forming carboxyhemoglobin. — why: Hemoglobin mistakes CO for oxygen. Once CO is stuck, hemoglobin cannot pick up or release real oxygen, so blood circulates but delivers almost nothing.
3. Brain cells starve first—headache, nausea, dizziness, and confusion appear. — why: Your brain burns 20% of your body's oxygen but is only 2% of your weight. When oxygen stops, brain cells scream for help by causing headache and dizziness.
4. Heart muscle starves—chest pain (angina), fast or irregular heartbeat (arrhythmias), and shortness of breath develop. — why: Your heart never rests and needs constant oxygen. Without it, the heart muscle hurts (chest pain) and its electrical rhythm becomes chaotic.
5. Severe poisoning causes fainting (syncope), seizures, and coma. — why: As brain oxygen debt grows, the brain cannot keep you conscious or control your body. Seizures are the brain's electrical system misfiring; coma is complete shutdown.
6. Heart stops (cardiac arrest) or breathing stops (respiratory arrest). — why: The heart and breathing centers in the brainstem run out of energy and quit. Without CPR and oxygen, the patient dies in minutes.

7. Even after rescue, delayed brain damage (delayed neurologic after-effects (sequelae)) appears days to weeks later. — why: Oxygen-starved brain cells swell, release toxic chemicals, and die slowly. This causes memory loss, personality changes, trouble walking, and parkinsonism in 10–40% of survivors.
8. In pregnant patients, fetal brain damage or fetal death occurs even when the mother recovers. — why: Fetal hemoglobin holds CO tighter and clears it slower than adult hemoglobin. The baby stays poisoned longer, and fetal brain cells are extremely sensitive to oxygen loss.

Spot it — what you see, and why

- Headache that feels dull and throbbing: Carbon monoxide sticks to hemoglobin (the part of red blood cells that carries oxygen) about 250 times better than oxygen does, so less oxygen reaches your brain. Your brain complains with pain when it is not getting enough fuel.
- Feeling dizzy or lightheaded: The brain needs a steady supply of oxygen to keep you balanced and aware. When carbon monoxide crowds out oxygen on your red blood cells, your sense of balance and clear thinking start to fade.
- Nausea or throwing up: The stomach and gut are sensitive to low oxygen. When tissues do not get enough fuel, the stomach can feel queasy and even reject food.
- Confusion or trouble thinking clearly: Your brain is the first organ to struggle when oxygen drops. Carbon monoxide keeps oxygen off the hemoglobin in your blood cells, so your thoughts get foggy and decisions become hard.
- Chest pain or a tight feeling in the chest: The heart muscle needs lots of oxygen to pump blood. When carbon monoxide blocks oxygen delivery, the heart may ache or squeeze, especially in people who already have heart disease or clogged arteries.
- Shortness of breath or feeling like you cannot get enough air: Even though your lungs are breathing fine, the blood cannot carry enough oxygen because carbon monoxide is hogging the seats on hemoglobin. Your body feels starved for air even when you are breathing normally.

Red flags — act now

- Passing out or becoming unresponsive
- New confusion or trouble thinking clearly
- Chest pain or feeling like the heart is squeezing
- Seizures or jerking movements
- Multiple people in the same building getting sick at the same time

Treat it — in this order

1. 100% oxygen via tight-fitting non-rebreather mask at 15 liters per minute, continued for at least 4 to 6 hours or until CoHb drops below 5% and symptoms resolve → Oxygen molecules compete with carbon monoxide for the binding sites on hemoglobin. Breathing 100% oxygen cuts the half-life of carbon monoxide (the time it takes for half of it to leave the body) from 4 to 5 hours on room air down to about 60 to 90 minutes, so carbon monoxide gets pushed off hemoglobin and exhaled much faster. This rapidly restores oxygen delivery to the brain and heart.
2. Hyperbaric oxygen (HBO) therapy at 2.5 to 3 atmospheres of pressure for 90 minutes, sometimes repeated once or twice over the next 24 hours in severe cases → High pressure forces oxygen to dissolve directly into the blood plasma (the liquid part of blood, not just the hemoglobin), cuts the carbon monoxide half-life to about 20 minutes (three times faster than 100% oxygen at normal pressure), and helps repair damaged mitochondria faster than regular oxygen alone. Studies suggest HBO reduces the risk of delayed neurologic injury (memory problems, personality changes, movement disorders that appear weeks later) from around 25 to 30 percent down to 10 to 15 percent in severe poisoning.
3. Hyperbaric oxygen is recommended (per current guidelines from the American Heart Association and the Undersea and Hyperbaric Medical Society) if any of these are present: loss of consciousness at any point during or after exposure, CoHb > 25%, pregnancy with CoHb > 15% or any neurologic symptoms (even mild confusion or headache), evidence of heart starved blood flow (ischemia) (chest pain, ECG changes, or troponin elevation), or persistent moderate-to-severe neurologic symptoms (confusion, seizure, focal weakness, vision changes) despite 4 to 6 hours of 100% oxygen at normal pressure → These criteria identify patients at highest risk for permanent brain or heart damage. Using HBO in these patients lowers the chance of delayed neurologic injury and speeds recovery of thinking and movement. It also protects the fetus in pregnant patients, whose babies are at high risk even when the mother feels better.
4. Treat coexisting cyanide poisoning with hydroxocobalamin 5 grams IV over 15 minutes (may repeat once) if the exposure was from a structural fire, enclosed-space fire, or burning plastics, synthetic materials, or foam → Fires release both carbon monoxide (from incomplete burning of any fuel) and hydrogen cyanide gas (from burning plastics, polyurethane foam, wool, silk, nylon, and rubber). Cyanide blocks cytochrome c oxidase (the final enzyme in the mitochondria that uses oxygen to make energy), so cells suffocate even when oxygen is present. Hydroxocobalamin (a form of vitamin B12) binds cyanide tightly in the blood and turns it into cyanocobalamin (safe vitamin B12), which the kidneys excrete in urine.

5. Treat smoke inhalation lung injury with humidified oxygen, nebulized albuterol 2.5 to 5 mg every 4 hours as needed for wheezing, and close monitoring of the airway; intubate early (within the first 2 to 4 hours) if a high-pitched noise on breathing in (stridor) (high-pitched breathing sound), severe face or mouth burns, soot in the nose or throat, or rapidly worsening breathing are present → Smoke and heat burn the lining of the airway (throat, windpipe, and bronchi), causing swelling that can close off the windpipe within hours, like a straw pinched shut. Albuterol (a bronchodilator) relaxes the muscles around the small airways and opens them up. Humidified oxygen soothes the inflamed tissue and loosens thick secretions. Early intubation (putting in a breathing tube) before the airway swells completely shut prevents the need for emergency cricothyrotomy (cutting the front of the neck to restore breathing).

Your top priorities at the bedside

1. Remove the patient from the carbon monoxide source immediately and make sure rescuers wear protective gear if the source is still active — why: Carbon monoxide keeps building up in the blood as long as the patient breathes it, so stopping exposure is the first step before any treatment can work, and rescuers can become victims themselves in high-concentration areas
2. Apply 100% oxygen using a tight-fitting non-rebreather mask at 15 liters per minute right away, making sure the reservoir bag stays inflated — why: High-flow oxygen floods the blood with oxygen molecules that compete with carbon monoxide for hemoglobin binding sites, and this speeds up the removal of carbon monoxide from the body by cutting the half-life from 5 hours on room air down to about 90 minutes
3. Place the patient on continuous cardiac monitoring and get a 12-lead ECG within the first 10 minutes — why: Carbon monoxide starves the heart muscle of oxygen, which can cause dangerous heart rhythms called arrhythmias or even a heart attack, and the heart damage may not cause obvious chest pain so monitoring catches silent problems