Carbon monoxide poisons thousands every year, and there are no good treatments

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Credit: AI-generated image (disclaimer)

Carbon monoxide is an undetectable yet lethal gas, often produced by incomplete combustion of carbon-based fuels, such as coal, gas and wood. It kills about 60 people a year in the UK, according to the NHS.

Although statistics on unintentional exposure to carbon monoxide are

hard to come by, about 4,000 people are thought to attend A&E each year as a result of exposure to the gas. The true figure is probably much higher because the symptoms of exposure to the gas aren't specific.

There is no antidote for carbon monoxide poisoning, nor is there any treatment for injury caused by exposure.

One of the ways that carbon monoxide causes harm is by combining with a protein called hemoglobin in red blood cells to form carboxyhemoglobin. This prevents the blood from carrying oxygen and prevents the tissues from using oxygen effectively, so people with carbon monoxide poisoning are essentially at risk of suffocation.

Not the whole picture

But the formation of carboxyhemoglobin is only a part of the picture—carbon monoxide also binds to other proteins in the body. The binding of carbon monoxide and hemoglobin begins to be reversed once the person is removed from the source of the gas, but the binding to other proteins can take longer. Also, carbon monoxide exposure causes an immune response and inflammation and so has a direct toxic effect on cells as a result. It is, in effect, a multifactorial poison.

Carbon monoxide exposure can cause harm whether people are exposed to high concentrations over a short period or low concentrations over a long period. Either method of exposure can lead to long-term health problems, including neurological complications, such as difficulties with memory and attention, as well as psychological and emotional problems.

Further difficulty exists because we can only measure carboxyhemoglobin from blood samples. There are no other biomarkers that doctors can use to measure the existence and extent of carbon monoxide exposure. And any long-term health problems from exposure

don't necessarily correlate with carboxyhemoglobin levels.

Patient in a hyperbaric chamber. Credit: James Heilman/Wikimedia Commons, CC BY-NC-SA

Also, even the measurement of carboxyhemoglobin is complicated by how much time has elapsed between removing the person from the source of exposure and testing for the presence of carboxyhemoglobin. Two minutes from removal to testing has been suggested as optimal, meaning that the diagnosis of carbon monoxide exposure may be missed altogether while harm from that exposure may still be significant but not

immediately apparent.

Hyperbaric oxygen therapy has been thought to prevent some of the undesirable effects of carbon monoxide exposure and lessen the risk of further damage, as it is comparatively quicker at removing carboxyhemoglobin than standard oxygen therapy. But its practical application has been limited by the time between diagnosis and treatment.

A Cochrane review (the gold standard for reviewing medical evidence) also failed to find enough evidence to support the use of hyperbaric oxygen therapy for carbon monoxide exposure. Hyperbaric oxygen therapy is no longer used by the NHS.

Light relief

Recent research in animals investigated a way of clearing the gas from the bloodstream using visible light (photo) therapy, which is known to disconnect carbon monoxide from hemoglobin. The researchers involved in this study treated carbon monoxide exposure in mice by applying phototherapy directly to their lungs. As a result, carboxyhemoglobin was lowered as the phototherapy removed the carbon monoxide from the hemoglobin and also doubled the rate of elimination of carbon monoxide from the bodies of the mice. The mice could exhale an increased quantity of carbon monoxide from their lungs, because of the phototherapy, when compared with the control group of mice which did not receive the phototherapy.

Another treatment, invented in the US in the 1970s, is called extracorporeal membrane oxygenation (ECMO). An ECMO machine is similar to the heart-lung bypass machine used in open heart surgery. Large cannulas (tubes) drain blood from the body. The machine then oxygenates the blood, removing carbon dioxide from hemoglobin. Used

to treat many kinds of respiratory and cardiac problems in children and adults, ECMO has also been used to treat carbon monoxide exposure.

However, ECMO is a complicated procedure and not an easy treatment for a sick person to endure. It is highly invasive and carries the risk of significant complications, requires the person receiving it to be ventilated and sedated, and is usually reserved for those very sick people who would not survive without it. It is usually only used when there are no alternatives.

These early-stage treatments offer hope for those affected by carbon monoxide, and future research in these areas may see some important breakthroughs in alleviating the harm that is caused. This is encouraging; we can decrease our vulnerability to death and injury by increasing our knowledge. But these deaths and injuries across the world are often caused just by heating our homes and cooking our food and are almost always entirely preventable.

My primary area of research is with those who have survived exposure. In many cases, these people's lives have been devastated and utterly fragmented by the experience. Any treatment that eased their suffering would be most welcome.

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