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The Carbon Monoxide Paradox

[At low levels, it reverses tissue death in mice](#)

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By Neil Sherman

HealthScout Reporter

WEDNESDAY, May 9 (HealthScout) -- A killer gas may actually be a lifesaver, surprising research in mice reveals. Researchers discovered that very low levels of carbon monoxide helped mice whose lungs had been starved of blood and oxygen to stave off death. The startling discovery could possibly lead to the use of carbon monoxide -- at the right concentrations -- to help stroke and heart attack victims.

"When you give very low levels of carbon monoxide, it actually causes the blood vessels to change some of their properties so that clots dissolve more readily," says lead author Dr. David Pinsky, an associate professor of medicine at Columbia University.

"During an emergency -- like a heart attack or stroke or severe infections like sepsis -- clots form rapidly in small vessels, choking off blood flow. In this case, small doses of carbon monoxide turn off the protein which inhibits clot dissolution, therefore allowing clots to dissolve where they wouldn't," he adds.

Carbon monoxide, a colorless, odorless gas, is usually toxic. Normally a by-product of the incomplete combustion of fuels, it enters the bloodstream after being inhaled and then

mimics the behavior of oxygen without providing its benefits. The gas is transported through the body, gradually starving the body's organs. This increases the body's need for oxygen, and the heart rate increases, which brings on poisoning at a more rapid pace.

As poisoning continues, the victim can suffer breathing difficulties, heart damage, brain damage and coma. Without fresh air, the victim can die.

Carbon monoxide's close resemblance to nitric oxide alerted Pinsky and his colleagues to its potential.

"Nitric oxide has very important biological functions within blood vessels -- it keeps blood flowing, keeps white cells from accumulating, and it keeps blood vessels from dilating," Pinsky explains. "Carbon monoxide can do some of the same things as nitric oxide, because they both bind to molecules of iron in the blood called heme proteins. And both activate an enzyme which signals cells to turn on and turn off various cell functions."

"Our hypothesis is that since nitric oxide and carbon monoxide do similar things, if nitric oxide is unavailable to do these normalizing routines in blood vessels, carbon monoxide might take over some of the same functions," Pinsky says.

To see if carbon monoxide worked like nitric oxide, Pinsky studied normal mice as well as mice that were unable to produce carbon monoxide in reaction to stress.

"Under stressful situations, the body reacts by producing carbon monoxide. For a long time it was thought to be an incidental by-product of cell death," he says.

Pinsky prevented blood flow to the right lungs of the mice for 30 minutes and then gave them very low levels of carbon monoxide.

None of the normal mice survived. But 50 percent of the mice unable to produce carbon monoxide recovered. Carbon monoxide's ability to reverse clot development prevented the lung tissue from dying, allowing the mice to survive, Pinsky says.

The findings were published in the May issue of *Nature Medicine*.

So does that mean carbon monoxide could be used to treat heart attack and stroke victims?

"With a lot of cautionary notes and a plea for further testing, perhaps," Pinsky responds. "So under a heart attack or stroke or sepsis or organ transplantation, the right amounts of

carbon monoxide might be beneficial. But we are not sure yet -- it must be tested."

It's not completely surprising that carbon monoxide may prove to be a therapeutic agent, according to Christoph Thiemermann of the William Harvey Research Institute in London. "The words carbon monoxide will for many of us immediately bring to mind the images of air pollution, of cigarette smoke, of suicides by inhalation of car exhaust fumes in closed garages," Thiemermann writes in an editorial accompanying Pinsky's article.

"Recently nitric oxide has been elevated from a common air pollutant . . . to an [internal] second messenger of utmost physiological importance," Thiemermann explains. "Therefore, many of us may not be entirely surprised to learn that carbon monoxide can paradoxically rescue the lung from [cardiovascular blockage] injury."

Whether carbon monoxide will become a treatment for stroke is still up for grabs, Thiemermann adds. "One could also argue that the use of [blood thinners] might be safer and just as effective as carbon monoxide inhalation in reducing [blood clot] deposition in the lung."

What To Do

This research is very preliminary. For all practical purposes, the gas remains a killer, so don't throw out your carbon monoxide detector just yet. (You *do* have a detector, don't you?)

For more information on carbon monoxide, visit the [Carbon Monoxide Headquarters](#) or the [Environmental Health Center](#).

And don't forget these HealthScout stories on [carbon monoxide](#).

SOURCES: Interview with David Pinsky, M.D., associate professor of medicine, Columbia University, New York; May 2001 *Nature Medicine*

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