Toronto General Hospital
University Health Network

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New first-aid method could prevent brain damage in patients exposed to carbon monoxide

TORONTO, December 3, 2002 – A new first-aid method of treating carbon monoxide poisoning could prevent brain damage in patients by delivering more oxygen to the brain than the standard treatment, according to a study by physicians at the Toronto General Hospital, University Health Network (UHN).

The study is published in the December issue of the U.S. based and peer-reviewed journal *Annals of Emergency Medicine.* The researchers, led by Dr. Josh Rucker, a Toronto General Hospital research fellow and resident in the Anesthesiology training program at the University of Toronto, studied 14 subjects who were exposed to low levels of carbon monoxide (resulting in blood levels about equal to those in heavy smokers) on two occasions in order to simulate conditions during carbon monoxide poisoning.

After each exposure, which lasted one hour, the participants were given one of two "test treatments": the standard treatment of 100% oxygen, or the new method consisting of a mixture of mostly oxygen and some carbon dioxide. Each participant received both test treatments in random order. Researchers then monitored the amount of oxygen in the blood and the blood flow to the brain during exposure to carbon monoxide and during the test treatments.

KEY RESULTS

- During the standard treatment with 100% oxygen, the flow of blood to the brain diminished, decreasing oxygen delivery to the brain. Results showed that the blood flow decreased by up to 33% and the oxygen delivered to the brain decreased by up to 20%.
- Such a decrease in blood flow to the brain is sufficient to contribute to brain damage in a patient with severe carbon monoxide poisoning.
- However, during treatment with the combination of oxygen and carbon dioxide, two effects were observed:
    - The delivery of oxygen to the brain was greater than during treatment with oxygen alone;
    - The rate of elimination of carbon monoxide increased by more than 20%.

"These results are intriguing," said Dr. Fisher, an anesthesiologist at Toronto General Hospital, University Health Network, Associate Professor in the Faculty of Medicine at the University of Toronto and a senior author of the study. "Most doctors believe that giving patients oxygen is like giving them chicken soup -- it can't hurt. But, in fact, we find that treating carbon monoxide-exposed participants with pure oxygen actually limits the amount of oxygen that gets to their brains. That is worrisome."

"If severely poisoned patients respond like our test subjects, this new first-aid treatment may decrease the extent of brain damage in survivors," added Dr. Joseph Fisher.

IMPLICATIONS

- This study raises the possibility that the standard first-aid treatment of carbon monoxide poisoning -- 100% oxygen - constricts blood vessels to the brain and decreases the total oxygen delivered to the brain.
- Researchers think that the small amount of carbon dioxide in the oxygen counteracts the constriction of blood vessels to the brain caused by the standard treatment with 100% oxygen.
- Although clinical studies need to be completed before recommending a change in the first-aid treatment of carbon monoxide poisoning, the results of this study suggest that simply maintaining carbon dioxide levels during treatment will result in more oxygen delivery to the brain, thereby decreasing the risk of permanent brain damage in severely poisoned patients.
    - Note: Adding carbon dioxide to oxygen during treatment for carbon monoxide poisoning was common in the late 1920s and 1930s.
    - It was thought then that the carbon dioxide stimulated breathing, helping to eliminate carbon monoxide more quickly, but was discontinued in the late 1940s when mechanical ventilators became available.
    - This study supports the re-introduction of this practice in order to maintain blood flow and oxygen delivery to the brain.

CARBON MONOXIDE POISONING

- Carbon monoxide is the leading cause of fatal poisoning in the industrialized world, as well as being endemic in many parts of the developing world which use fossil fuels
- In North America, it results in as many as 70,000 emergency room visits a year and in thousands of deaths
- Up to 30 per cent of survivors of severe poisoning are left with disabling psychological and neurological symptoms, which sometimes last for years
- Carbon monoxide is an odorless colorless gas formed during incomplete combustion of the fossil fuels - gas, oil, coal and wood used in boilers, engines, gas fires, water heaters, solid fuel appliances and open fires
- When carbon monoxide is inhaled--even in tiny concentrations--it combines with the hemoglobin in the red blood cells to prevent the delivery of oxygen to the body
- This results in few symptoms until the poisoning is advanced
- Those suffering from carbon monoxide poisoning may initially complain of headache, nausea and fatigue but the symptoms can rapidly progress to coma and even death

- It is therefore critical that carbon monoxide be eliminated from the body as soon and as quickly as possible
- The only currently available emergency treatment for carbon monoxide poisoning is giving the patient 100 per cent oxygen

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TORONTO GENERAL HOSPITAL, UNIVERSITY HEALTH NETWORK
Toronto General Hospital is a partner in University Health Network, along with Toronto Western and Princess Margaret Hospitals. The scope of research and complexity of cases at Toronto General Hospital has made it a national and international source for discovery, education and patient care. It has one of the largest hospital-based research programs in Canada, with major research projects in cardiology, transplantation, surgical innovation, infectious diseases, and genomic medicine. Toronto General Hospital is a teaching hospital affiliated with the University of Toronto.

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