

Inhaling hydrogen may help reduce lung damage in critically ill patients

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Inhaling small amounts of hydrogen in addition to concentrated oxygen may help stem the damage to lung tissue that can occur when critically ill patients are given oxygen for long periods of time, according to a rat model study conducted by researchers in Pittsburgh. The study also found hydrogen initiates activation of heme-oxygenase (HO-1), an enzyme that protects lung cells.

The results will be presented at the ATS 2011 International Conference in Denver.

"We found that inhalation of [hydrogen](#) can reduce hyperoxic lung injury that occurs as the result of exposure to concentrated oxygen for prolonged periods, an important problem in critically ill, ventilated patients," said Tomohiro Kawamura, MD, research fellow at the University of Pittsburgh's Thomas E. Starzl Transplantation Institute. "Administering hydrogen treatment by providing gas for the patient to inhale is a new approach and may be feasible in clinical practice."

Highly concentrated oxygen is routinely administered to critically ill patients who cannot breathe efficiently, such as patients with severe heart or lung disease. Given over a prolonged period, oxygen toxicity can occur, causing severe lung injury which can lead to [respiratory failure](#). In this study, the researchers hypothesized that the addition of hydrogen, which has potent antioxidant and anti-inflammatory effects, might help mitigate the damage caused by prolonged exposure to concentrated oxygen.

To find out, the researchers assigned male rats assigned to four experimental groups: rats exposed to high concentrations of oxygen and either 2 percent nitrogen or 2 percent hydrogen, and rats given normal levels of oxygen and either 2 percent nitrogen or 2 percent hydrogen. Exposure periods for all groups were 60 hours. Lung function was evaluated by blood gas analysis of the arterial blood, and body weight, lung fluid volume,

inflammatory cell count in lung fluids and HO-1 levels were measured.

Comparing oxygen exposure groups to controls, the researchers found exposure to 2 percent nitrogen with 98 percent oxygen for 60 hours markedly impaired lung function and caused inflammation and a build-up of fluid in the lung. In contrast, rats exposed to 2 percent hydrogen with 98 percent [oxygen](#) had less swelling and improved lung function, as well as significant reductions in inflammation compared to controls. In addition, levels of HO-1 were elevated in rats exposed to hydrogen.

"Hydrogen-induced hemeoxygenase-1 is a protein that protects the cells and has antioxidant and anti-inflammatory activities," Dr. Kawamura noted. "HO-1 induction protects against harmful stimuli, including hyperoxia.

"HO-1 induction in the lung may be one of the mechanisms underlying the protective effects of hydrogen," he added. "Our study is the first to show induction of HO-1 by hydrogen, and our results suggest that hydrogen functions by inducing protective proteins such as HO-1."

Dr. Kawamura said he and his colleagues have conducted extensive research on the beneficial effects of hydrogen in lung injuries.

"In one recent mouse study, we showed that inhaled hydrogen could prevent acute lung injury induced by mechanical ventilation, and we also showed that inhaled hydrogen gas therapy for lung transplant donors and recipients reduced some transplant-associated injuries in a [rat model](#) study," he said.

The results of this study indicate hydrogen inhalation therapy may have applications in other lung injuries, he added.

"Hydrogen has a therapeutic potential not only in treating acute [lung injury](#), but also in treating chronic [lung](#) diseases such as chronic obstructive pulmonary disease (COPD), which is the fourth leading cause of death in the U.S.," he said.

"Hydrogen may help prevent progression of COPD, which could have a huge impact on treatment.

"Administering hydrogen treatment by providing gas for the patients to inhale is straightforward and may be feasible in clinical practice in the future," Dr. Kawamura added.

Future research should focus on establishing efficacy and safety profiles of hydrogen inhalation therapy in animal models, prior to its possible use in a clinical setting, he said.

Provided by American Thoracic Society

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