Combined hyperbaric O2: Normobaric hyperoxia associated with improved outcome of severe TBI

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Researchers at the Hennepin County Medical Center, University of Minnesota, and Minneapolis Medical Research Foundation (Minneapolis, Minnesota) report that the combined use of hyperbaric oxygen and normobaric hyperoxia therapies provides better outcomes in patients with severe traumatic brain injury (TBI) than the standard intensive neurosurgical care recommended for this injury. Full details on the effects of this combined treatment are provided in the paper "A prospective, randomized Phase II clinical trial to evaluate the effect of combined hyperbaric and normobaric hyperoxia on cerebral metabolism, intracranial pressure, oxygen toxicity, and clinical outcome in severe traumatic brain injury. Clinical article," by Drs. Sarah and Gaylan Rockswold and colleagues, published today online, ahead of print, in the *Journal of Neurosurgery*.

In hyperbaric oxygen (HBO_2) therapy, the patient is placed in a pressure chamber set at an atmospheric pressure higher than normal and given pure oxygen; in normobaric hyperoxia (NBH) therapy, patients receive pure oxygen at normal atmospheric pressure. Both treatments are designed to improve the amounts of oxygen delivered to organs and tissues throughout the body.

In their paper, Rockswold and colleagues cite previous findings that hyperbaric oxygen (HBO_2) therapy has beneficial effects in cases of severe TBI: at the end of treatment the brain is better able to use

available oxygen. Normobaric hyperoxia (NBH) treatment has also been shown to be beneficial in cases of severe TBI. The researchers hypothesized that combining these two treatments could prove synergistic and produce even better outcomes in patients with severe TBI.

Forty-two (42) patients with severe TBI (Glasgow Coma Scale score of 8 or less) were randomly assigned to one of two treatment groups within 24 hours after injury. One group of 22 patients (control group) received the "standard" intensive neurosurgical care prescribed for severe TBI. This consisted of endotracheal intubation and stabilization of the patients' condition in the emergency department, surgery to remove significant hematomas, continuous monitoring of intracranial pressure (ICP), and treatment of ICP if it increased above normal levels (intracranial hypertension). In addition, all patients received phenytoin sodium to prevent potential seizures. The second group of 20 patients received hyperbaric oxygen therapy followed by normobaric hyperoxia treatment in addition to standard care. These patients received the combined HBO_2/NBH treatment while in a pressure chamber. First, pure oxygen was delivered at 1.5 times normal atmospheric pressure (hyperbaric oxygen [HBO_2] therapy). This treatment lasted 60 minutes and was followed by 3 additional hours of pure oxygen delivery at normal atmospheric pressure (normobaric hyperoxia [NPH] therapy). The combined treatment took place every 24 hours over a 3-day period.

The group of patients who received the combined HBO_2/NBH treatment fared better overall than the group of patients who received standard care. In a comparison between the two groups, the researchers found that combined HBO_2/NBH treatment

- reduced the mortality rate and improved the rate of favorable outcomes (measured by applying the Glasgow Outcome Scale 6

months after treatment)
- improved markers of cerebral oxidative metabolism in areas of the brain that were relatively undamaged as well as in the region of injury
- reduced intracranial hypertension and, consequently, reduced the intensity of treatment needed to lower intracranial pressure
- did not create oxygen toxicity in the brain or lungs, which can occur when excessive amounts of oxygen are present
- effected greater improvements in clinical outcomes than have been observed in previous studies in which HBO_2 or NBH treatment was used alone

This is the first report of a Phase II clinical trial of combined HBO_2/NBH treatment for severe TBI. According to Dr. Gaylan Rockswold, "Although the number of patients in this trial was relatively small, the improvement in neurological recovery was dramatic—better than outcomes of previous treatments for traumatic brain injury. We are pursuing funding for a larger randomized clinical trial from NIH to further evaluate this treatment for TBI."

More information: Rockswold SB, Rockswold GL, Zaun DA, Liu J. A prospective, randomized Phase II clinical trial to evaluate the effect of combined hyperbaric and normobaric hyperoxia on cerebral metabolism, intracranial pressure, oxygen toxicity, and clinical outcome in severe traumatic brain injury. Clinical article. Journal of Neurosurgery, published online, ahead of print, March 19, 2013; DOI: 10.3171/2013.2.JNS121468

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