

# Can Postoperative Cognitive Dysfunction Be Prevented?

**Richard A. Neubauer, M.D.**  
**Charles Golden, Ph.D.**

At the Oct 26, 2004, annual scientific session of the American Society of Anesthesiologists (ASA) in Las Vegas, striking observations were presented of an important problem that has not received adequate attention: postoperative cognitive dysfunction (POCD).

Terri Monk, M.D., Professor of Anesthesiology at Duke University,<sup>1</sup> reported a follow-up to previous work.<sup>2,5</sup> She and her coworkers have shown that psychometric testing reveals POCD in 35% of young patients (< 40 years old), 56% of middle-aged patients (40-59 years old), and 69% of older patients at 1 week after major, noncardiac surgery. Three months postoperatively, 6.7%, 13%, and 24% of the patients, respectively, still had measurable impairment.<sup>4</sup> POCD was defined as a decline of 20% or more on at least 20% of the psychometric tests performed preoperatively and at 1 week and 3 months postoperatively. Elderly patients with POCD 3 months after surgery had an increased incidence of intraoperative cerebral oxygen desaturation.<sup>4</sup> Patients having cardiac or neurosurgical procedures were excluded, as were those with a history of neurologic disorder, drug abuse, or depression, or a score of less than 24 on the Mini-Mental State Examination.

Similar problems have long been observed after cardiac surgery, but little has been done about it.

It is highly unlikely that this problem is indigenous to North Carolina. Wondering whether it is a worldwide phenomenon, we contacted physicians we have met in the course of lecturing in 36 countries on the use of hyperbaric oxygenation therapy (HBOT) in neurologic conditions.

Dr. Natalia Kazantseva, head of the Russian Space Agency and a consultant in hyperbaric medicine in Russia, stated that she was unaware of POCD. Years ago, Dr. Sergie Efouni established about 1,000 hyperbaric centers that routinely treat seriously ill elderly patients preoperatively and postoperatively. According to Dr. Rafael Castellanos, who is in charge of the 33 centers in Cuba and who was taught by the Russians, the elderly and even younger patients are brought to undergo extensive surgery are pretreated with hyperbaric oxygenation. In Taiwan, at-risk patients are also treated pre- and postoperatively, said Dr. Alan Ko Chi Niu. In China, many surgical procedures, especially open-heart surgery, are actually done in a hyperbaric chamber. Dr. Lianbi Xue, former president of the Chinese Hyperbaric Society, claims that POCD does not exist in China and that various other serious long-term surgical complications have been significantly reduced.

On our visit to Beijing, we saw hyperbaric chambers that would accommodate up to 36 patients. These were compressed with air, and oxygen was administered by mask or hood. HBOT is used extensively in conjunction with acupuncture and traditional herbal medicine, and is said to be a very cost-effective approach.

One possible mechanism for a benefit from HBOT is amelioration of an inflammatory process that makes white cells adhere to the endothelium, as a consequence of reduced cerebral blood flow. It has been demonstrated that two sessions of postoperative HBOT in adults undergoing partial hepatectomy decrease sinusoidal endothelial cell damage caused by activated neutrophils.<sup>6</sup>

While the mechanism of injury is of interest, the key question is whether the injury can be prevented or ameliorated by the noninvasive intervention of administering oxygen under pressure before and after major surgery such as knee replacements.

Experience in other nations is suggestive, although reports from clinical impressions, especially in Communist countries, must always be viewed with skepticism. The occurrence of POCD cannot be excluded without rigorous measurements comparable to those undertaken by Monk et al. Our clinical work with chronically brain-injured (CBI) adults and children has convinced us of the potential for HBOT. We observe improvement on single-photon emission computerized tomographic (SPECT) brain scans<sup>7</sup> and also in clinical observations.<sup>8</sup> Studies comparing treated and untreated CBI subjects showed that both adults and children made significant gains in neurophysiologic test measures after HBOT, compared with minimal test-retest improvements in untreated controls.<sup>9</sup>

A controlled study of the effect of pre- and postoperative HBOT treatment on POCD would probably be necessary before widespread adoption of the practice could occur in the United States. There are many barriers. The 600 hyperbaric centers that exist in the United States are primarily devoted to the 14 conditions covered by Medicare. Research funding is mostly devoted to pharmaceutical interventions.

With the rapid aging of the U.S. population, the substantial burden of caring for cognitively impaired older persons and increasing recognition of POCD may finally provide the stimulus needed for performance of research on neurologic applications of HBOT.

**Richard A. Neubauer, M.D.**, is Medical Director, Ocean Hyperbaric Neurologic Center in Lauderdale-by-the Sea, FL. Contact: ran@oceanhbo.com. **Charles Golden, Ph.D.**, is Professor of Neuropsychology, Nova Southeastern University, Ft. Lauderdale, FL.

## REFERENCES

- 1 Monk TG, Phillips-Bute BG. Longitudinal assessment of neurocognitive function in elderly patients after major, noncardiac surgery [abstract A-62]. ASA Annual Scientific Session, Las Vegas, Nev., Oct 26, 2004.
- 2 Monk TG, Garvan CW, Dede DE, van der Aa MT, Gravenstein JS. Postoperative cognitive dysfunction is more common in the elderly following major surgery [abstract A-48]. ASA Annual Scientific Session, San Francisco, Calif., Oct 14-18, 2000.
- 3 Monk TG, Garvan CW, Dede DE, van der Aa Mt, Gravenstein JS. Predictors of postoperative cognitive dysfunction following major surgery [abstract A-50]. ASA Annual Scientific Session, New Orleans, La., Oct 13-17, 2001.
- 4 Monk TG, Weldon BC, Weldon JE, van der Aa MT. Cerebral oxygen desaturations are associated with postoperative cognitive dysfunction in elderly patients [abstract A-40]. ASA Annual Scientific Session, Orlando, FL, Oct 12-16, 2002.
- 5 Price CC, Garvan CW, Monk TG. Neurocognitive performance in older adults with postoperative cognitive dysfunction (POCD) [abstract A-899]. ASA Annual Scientific Session, San Francisco, Calif., Oct 11-15, 2003.
- 6 Ueno S, Tanabe G, Kihara K, et al. Early post-operative hyperbaric oxygen therapy modifies neutrophil activation. *Hepato-Gastroenterology* 1999;46:1798-1799.
- 7 Golden ZL, Neubauer R, Golden CJ. Improvement in cerebral metabolism in chronic brain injury after hyperbaric oxygen therapy. *Intern J Neuroscience* 2002;112:119-131.
- 8 Neubauer RA, James P. Cerebral oxygenation and the recoverable brain. *Neurol Res* 1998;20(Suppl 1):533-536.
- 9 Golden C. Improving cognitive function after chronic brain injury with hyperbaric oxygen treatment. Presented at: XIII International Congress on Anti-Aging Medicine, American Academy of Anti-Aging Medicine, Las Vegas, Nev., Dec 2, 2004.