# HYPERBARIC OXYGEN THERAPY (HBOT) FOR AUTISM:

## AN INTRODUCTION

By Kyle Van Dyke, MD

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Hyperbaric oxygen therapy (HBOT) is the use of inhaled air under pressure with added oxygen. For decades, it has been used in mainstream medicine at high pressures (greater than 2 atmospheres) to treat issues ranging from the bends to diabetic wound infections, but only in the last several years has mild hyperbaric therapy (using 1.3 to 1.5 atmospheres with or without added oxygen) been used by physicians for children with autism. I first became aware of the use of mild hyperbarics for autism four years ago when Dr. Dan Rossignol, who was doing a study on autism and hyperbarics, asked if we would like our 3-year-old son, Ryan, to be in the study. At first the treatment did not make sense to me: why would you treat a condition associated with oxidative stress with oxygen under pressure? However, Dr. Rossignol convinced me that it was safe and that there were good reasons why it could work in autism.

He had completed a retrospective study[1] (a study that looks at the results of a specific treatment already completed) on a small group of children, and the study showed benefit. The new study[2] would be a prospective study that would measure markers of oxidative stress before and after treatment and assess behavior changes. Our son was part of that study, which showed no worsening

of oxidative stress with hyperbarics. As a result of the treatment, our son's language, sociability, and overall cognition improved greatly. In addition, he had the first normal bowel movement in his life (he had suffered with chronic diarrhea for years).

Dr. Rossignol followed up that study with a new study that was published in March 2009[3]. In it, he compared hyperbaric therapy at 1.3 atmospheres pressure against sham therapy at 1.03 atmospheres. (1.03 atmospheres was the lowest pressure that could mimic hyperbaric therapy; since the chambers are still slightly pressurized it is not a true placebo but a sham treatment.) Patients, treating physicians, and psychologists were blinded as to which children received which treatment. They did multiple tests to assess behavioral changes. The study showed significant improvement in the treated group when compared to the sham treatment group.

What is hyperbarics doing, and why does it seem to help children with autism? No one is sure of the exact mechanism, but there are several different explanations. We know from SPECT (single photon emission computed tomography) scan studies that the brains of children with autism can have areas of hypoperfusion (low blood flow). By increasing the air pressure, we are increasing the amount of oxygen that is diffused into the serum and increasing the delivery of oxygen to the brain. We know from autopsy studies of the brains of children with autism that chronic inflammation occurs[4], and we also know hyperbarics has an anti-inflammatory effect. In addition, hyperbarics has also been useful in treating inflammatory bowel diseases[5], and many children with autism have terrible gastrointestinal (GI) inflammation. We know that some children with autism have dysfunctional

mitochondria, the energy generating parts of the cell. Animal studies have demonstrated increased mitochondrial efficiency[6] and also increased mitochondria density[7] with hyperbaric therapy.

Typical treatment with hyperbaric oxygen therapy involves sitting in a chamber that is pressurized. (Both soft and hard shell chambers are used. Soft chambers typically use 1.3 atm. Hard chambers can go to higher pressures but usually do not exceed 1.5 atm in autism. Hard chambers can also use increased oxygen concentrations.) During pressurization and depressurization, occupants feel a popping sensation in their ears similar to ascending in a plane. Once at pressure, the patient and caregiver (an adult always goes in with the child) stay in the chamber for 60 to 90 minutes and then depressurize. Typically, treatments are done once or twice daily Monday through Friday, usually for a total of 40 sessions. Depending on the clinic and type of chamber, patients may be treated at 1.3 to 1.5 atmospheres pressure and may inhale room air (21% oxygen) or concentrated oxygen (from 24% to 100%). There are very few contraindications to hyperbaric treatment, and most patients without significant lung disease can be treated without problems.

I now work at a clinic that uses HBOT. I continue to see good results not only for my son Ryan but also for many patients who have been treated here. Children with autism have come in for treatment; like our son, they frequently make impressive gains in language, social interaction, GI function, and overall cognitive function.

Some of the more dramatic results of HBOT have been seen in children with mitochondrial diseases. For example, Grace was diagnosed with a rare mitochondrial disease called cytochrome C reductase deficiency when she was 2 years old. She had been in the hospital for nearly her whole life suffering from constant seizures and cortical blindness, and she was bed bound and had failure to thrive. Her mother started using mild hyperbarics when Grace was 3. She stopped having seizures (and eventually stopped all anticonvulsants), her vision normalized, and after several years of therapy she got out of her wheelchair and walked for the first time in her life. Grace is now 10 and has continued to progress.

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Mayci has a mitochondrial disease (complex I and II deficiency) that gave her constant seizures uncontrolled by multiple medications. She was wheelchair bound and nonverbal. After her second day of mild hyperbarics, her seizures stopped and have not recurred. After a year of therapy, she is now learning to crawl and starting to say a few words to the delight of her mother.

A 7-year-old girl with autism, eosinophilic esophagitis (an immune/inflammatory condition of the upper GI tract causing frequent vomiting), and suspected mitochondrial disease was getting progressively worse. She could tolerate very few foods, was constantly vomiting, and was not gaining weight. Her mother said she was "watching her dying in front of my eyes." After her third mild hyperbaric treatment, the child said she was hungry and started eating without vomiting. In the several months since, she has gained weight and her overall cognition has improved to the point where she is arguing with her brother in a totally typical fashion.

Most children have slow steady gains over the usual 40 treatments, but recently a minimally verbal 4-year-old boy came in for his first treatment on a Friday afternoon. When he came out, he shocked his mother by asking her a question for the first time. After the single treatment at 1.5 atmospheres, he continued talking all weekend and amazed his teachers with his improvement the following Monday. He continues to make gains in his first treatment round.

Sometimes hyperbarics is used to help prevent regressions. A young boy had been doing well on biomedical treatments including a previous round of hyperbarics. When he got a DTaP booster shot, his mother immediately noticed he was losing his skills and having staring spells. While waiting for a neurologist appointment, she restarted mild hyperbarics; he was back to himself after the initial treatment and the staring spells stopped. We have also used hyperbarics on our son after surgical procedures to speed healing and help prevent regressions we had seen after anesthesia in the past.

Hyperbaric therapy is not a cure for autism, but it is a new and powerful tool we can use in the biomedical treatment of autism.

## References


[1] Rossignol DA, Rossignol LW: Hyperbaric oxygen therapy may improve symptoms in autistic children. *Med Hypotheses* 2006,67(2):216-22.

[2] Rossignol DA, Rossignol LW, James SJ, Melnyk S, Mumper E: The effects of hyperbaric oxygen therapy on oxidative stress, inflammation, and symptoms in children with autism: an open-label pilot study. *BMC Pediatr* 2007, 7(1):3.

[3] Rossignol D. Hyperbaric treatment for children with autism: a multicenter, randomized, double-blind, controlled trial. *BMC Pediatrics* 2009, 9:21.

[4] Vargas DL, Nascimbene C, Krishnan C, Zimmerman AW, Pardo CA: Neuroglial activation and neuroinflammation in the brain of patients with autism. *Ann Neurol* 2005, 57(1):67-81.

[5] Buchman AL, Fife C, Torres C, Smith L, Aristizibal J. Hyperbaric oxygen therapy for severe ulcerative colitis. *J Clin Gastroenterol* 2001;33(4):337–9.

[6] Kurt B. Effects of hyperbaric oxygen on energy production and xanthine oxidase levels in striated muscle tissue of healthy rats. *Journal of clinical Neuroscience* 2008:15.

[7] Gutsaeva D.R. Oxygen-induced mitochondrial biogenesis in the rat hippocampus *Neuroscience* 2006:137.