

HOW MILD HYPBERBARIC OXYGEN WORKS AND WHY IT IS GOOD FOR OUR CHILDREN WITH AUTISM SPECTRUM DISORDERS

Julie A. Buckley, MD, FAAP

What is Autism?

Often misunderstood as a psychiatric problem, increasingly, autism is being recognized as an illness that develops when a genetically vulnerable child experiences more environmental exposure to potentially toxic substances than they can tolerate. The result is not a behavioral disorder, but a series of systems disorders. Specifically, vicious cycles disrupt normal responses to environmental exposure, normal management of oxidative stress, normal function of the gut, and normal function of the immune system. Although there is primary neurologic impact on the brain, the secondary impact resulting from other systems disorders is significant.

As research elucidates with increasing clarity the mechanisms of injury, understanding why some therapies work and why others might work opens up new avenues for recovery. Hyperbaric oxygen therapy is a therapy being widely used in Autism Spectrum Disorders with widespread and significant success. The reasons for the success of hyperbaric oxygen therapy and the best regimens of therapy have yet to be completely determined, but research is well under way.

What does hyperbaric oxygen do?

Physicists figured out years ago that a gas under pressure is more likely to dissolve into liquid- in mild hyperbaric oxygen therapy, the gas is oxygen and the liquid is blood. But under pressure, oxygen doesn't just hook up to red blood cells the way we're used to thinking about it, it also dissolves into the plasma. When that plasma circulates near dormant or injured tissue such as an autistic brain, a bruised muscle, a sprained tendon, or a surgical wound, the oxygen in the plasma dissolves further into the damaged area than the oxygen that's attached to the red blood cell in the conventional delivery system can.

How much is too little and how much is too much?

A little oxygen is room air- 21% FiO₂- and it loads 93-98% of your red blood cells with oxygen every time they pass through your lungs. This keeps most of us going day in and day out. A lot of oxygen- virtually 100% FiO₂- is what divers breathe from their tanks- and what they use in high pressure hard shell chambers at hospitals - it's potentially explosive and can be toxic to your body if you get too much for too long. Higher pressures and high levels of oxygen can be necessary when treating a diver who has "the bends" and certain wounds that won't heal. But the world of hyperbaric medicine is learning that lower pressures and less oxygen seem to have excellent effect on multiple systems of our bodies. In particular, lower pressure appears to be more beneficial for the injured brain than higher pressure.

So, how much is just right?

Somewhere in between too little and too much is what the mild hyperbaric chamber does. It pressurizes us to 1.3 atmospheres of pressure, effectively like going to the bottom of an 11 foot swimming pool and hanging out there with air to breathe and ears that are equalized. The experience feels like what happens when a pilot pressurizes an airplane cabin. When we fly they increase the cabin pressure to maintain something close to room air for us while we are at altitude in the “thin” oxygen poor air of our friendly skies.

When we use a concentrator we enrich the oxygen in the chamber even more- the concentrator removes most of the nitrogen that is in room air delivering more concentrated O₂ through a small accessory tube to which we can attach a mask if a child will wear it. The end result is something more than 21% FiO₂ and less than 100% FiO₂ and will vary depending on whether or not a child will wear a mask or sit near the accessory oxygen.

Experience indicates our children probably get about 40% FiO₂ overall in the mild hyperbaric chamber with a concentrator on. Lower pressures and smaller increases in oxygen content like the environment generated in the mild chamber seem to be ideal for promoting healing of dormant and injured cells.

Oxygen- if a little is good, more is not necessarily better

Remember that a little oxygen is good, too much oxygen is toxic and can actually induce oxidative stress (impairing healing of any sort), and in between there somewhere is superb. This is true because the human body's relationships with oxygen are almost all curvilinear- sigmoid “s” shapes, bell curves that start low, go high, and come back down low with increasing numbers across the bottom of the graph, so that there can actually be a bad effect from too much. If a little is good, more is not necessarily better is an important concept in mild hyperbaric oxygen therapy.

How does the increase in oxygen help my child?

Recall that increased pressure dissolved more oxygen into the plasma in addition to loading up all of the red blood cells. When that oxygen enriched plasma circulates near dormant or injured tissue such as an autistic or encephalopathic brain, a bruised muscle, a sprained tendon, or a surgical wound, the oxygen dissolves further into the damaged area than the oxygen that's attached to the red blood cell in the conventional room air way. It penetrates deeper, allowing for potential healing in a place that either wouldn't happen at all (the autistic or encephalopathic brain) or wouldn't happen for a while until the more superficial tissue heals first (the sprains and bruises and surgical wounds)

How do we know the oxygen actually does some healing?

We can look to apparent healing of the brain by monitoring its perfusion and activity. We can also monitor behaviors, response to stimuli (sensory function) and motor skills. Monitoring of perfusion and activity, of the relative numbers of dormant, sleeping or alert and functioning brain cells is done with a Brain SPECT (Single Photo Emission Computed Tomography) scan. At <http://www.hbot4u.com/brainscans.html> you can see

SPECT scan pictures of a 17 year old boy's brain who had autism, poor grades, poor social skills, and seizures. The scan looks at blood flow/activity of the brain, and it's quantified across the rainbow/spectrum of color. Purple/blue is low flow and activity- those dormant sleeping neurons, through green, and up to yellow into red with intensification to white being high flow/activity. The second set of pictures as you scroll down this web page is his brain a year after he completed 50 sessions. You can see the dramatic increases in the front of the brain where social skills "live", and the sides of the brain where language "lives".

Note that this young man's sessions were stopped after 50- although there was dramatic improvement in his SPECT scan, it didn't "light up" all areas of the brain- would other areas have improved with more time? With lower pressures and less O₂ in the mild chambers that are FDA approved for use in the home, we can potentially continue daily therapy indefinitely. The possibility of continued steady improvement is very real and in fact, our long term patients give testimony to ongoing improvements that constantly evolve.

Is this the magic bullet we've been awaiting?

Mild hyperbaric oxygen will not be the panacea. Once revitalized, the brain cells still have to be trained to do what they were intended to do (i.e. therapy) and they'll still need ongoing metabolic support (nutrition and vitamin supplementation) to complete their rehabilitation. Remember too, that the brain is only one area that needs healing in our children. That being said, oxygen is critical to most processes within the human body and perhaps the best description of its role will be to augment to every therapy and treatment a child is offered.

What are we doing to figure out how hyperbaric oxygen helps our children?

An initial evaluation of how mild hyperbaric oxygen influences characteristics of autism will be reviewed. ATEC (Autism Treatment Evaluation Checklist- a severity rating scale of several symptoms often associated with autism developed by the Autism Research Institute) ratings were monitored regularly over the course of therapy with mild hyperbaric oxygen. Three children who had SPECT brain scans before starting therapy and after 40 sessions. Significant improvements on these children's SPECT scans correlated with statistically significant improvements in their ATEC scores. These results quantify the plethora of parental and physician testimony to often dramatic improvement in our children receiving hyperbaric oxygen therapy.

This pilot study has spawned a plethora of ongoing research. There are two large studies ongoing to document, with several scales, the improvement in children with autism when they receive hyperbaric oxygen therapy. Additionally, several smaller studies are beginning to attempt to answer the questions surrounding mechanisms of action in autism spectrum disorders.

So what's the bottom line?

We know that our children have sustained benefit from 20, 30, and 40, 100 and 200 sessions of mild hyperbaric oxygen. Testimonials of parents and physicians have documented this and research needs to confirm it. I suspect that if we continue to use

mild hyperbaric oxygen over the course of a child's lifetime, in daily doses of one to two hours a day, we may eventually be able to revitalize much of their dormant brain tissue. I also suspect we will find positive impact on immune function, gut healing, and detoxification. There is a tremendous amount to learn in this area, but it is resoundingly clear that mild hyperbaric oxygen therapy has quite a role to play in getting our children healthy and ready to take an active role in society.