

HYPERBARIC OXYGEN THERAPY FOR CEREBRAL PALSY CHILDREN

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To significantly increase the delivery of oxygen to the tissues requires the use of hyperbaric conditions, that is, pressures greater than normal sea level atmospheric pressure. When tissue is damaged, the blood supply within the tissue is also damaged and too little oxygen may be available for recovery to take place. Hyperbaric medicine is not taught in most medical schools and is often dismissed by doctors as "alternative" medicine, but it is drugs that are alternative. Some raise fears about toxicity but in practice, this is not a problem. More is known about oxygen and its dosage than any pharmaceutical.

There is no more important intervention than to give sufficient oxygen to correct a tissue deficiency but, unfortunately, oxygen is only given in hospital to restore normal levels in the blood. The increased pressure has no effect on the body, although the pressure in the middle ear and sinuses in adults has to be equalized. More oxygen may help many children with cerebral palsy, but it is NOT a cure. There are some obvious questions to be answered: When does the damage occur? Ultrasonic scanning of the brain has shown that in most children the events which cause the development of cerebral palsy (CP) occur at the time of birth, ¹ although it may be many months before spasticity develops.² Where does the damage occur? The areas affected in CP are in the middle of the hemispheres of the brain and one side or both sides may be involved.

These critical areas, called the internal capsules, are where the fibers from the controlling nerve cells in the gray matter of the brain pass down on their way to the spinal cord. In the spinal cord, they interconnect with the nerve cells whose fibers activate the muscles of the legs and arms. Why does the damage occur? Unfortunately, the internal capsules have a poor blood supply, shown by the frequent occurrence of damage to these areas in younger patients with multiple sclerosis and in strokes in the elderly by Magnetic Resonance Imaging (MRI). When any event causes lack of oxygen the blood vessels leak, the tissues become swollen and there may even be leakage of blood. The increased water content, termed edema, reduces the transport of oxygen. This applies to any tissue, but especially to the brain where a sufficient quantity of oxygen is vital both to the function and, in children, its development. What causes paralysis and spasticity to develop? When the controlling nerve cells in the brain are disconnected from the spinal cord, the signals to the arms and legs cannot pass and the ability to move is lost. Eventually, because the nerve cells in the spinal cord are separated from the control of the brain, they send an excess of signals to the muscles, causing the uncontrolled contractions known as spasticity.

The areas carrying the nerve fibers to the legs are the closest to the ventricles of the brain where the blood supply is poorest³ so the legs are the most commonly affected. This is called diplegia, to indicate that the problem is in the brain and distinguish it from paraplegia where the damage is in the spinal cord. Why is spasticity delayed? This crucial question is, at present, not adequately explained or even raised. Children who develop spasticity often appear to develop normally for several months and then lose function gradually. Because in many children there is voluntary movement for a time after birth, the connections must still be intact. Why then are they lost allowing spasticity to develop? The answer almost certainly is due to the failure of the coverings of the nerve fibers, known as myelin sheaths, to develop. This evidence has come from MRI.² Myelin sheaths envelope the nerve fibers like a Swiss roll in order to increase the speed of impulse transmission.

Myelination normally begins about a month before birth and progresses to completion by the age of two. If there is, tissue swelling in the mid-brain the delicate cells that form myelin die and the nerve fibers, left exposed, slowly deteriorate with the ultimate development of spasticity. What may be possible? Loss of function in the brain can be due to either tissue swelling, which is reversible, or tissue destruction, which is not. The recoverable areas can now be identified by a technique called SPECT imaging. The initials stand for Single Photon Emission Computed Tomography. It can demonstrate blood flow, which is linked to metabolism of the brain, which is, of course, directly related to oxygen availability. By giving oxygen at the high dosages possible under hyperbaric conditions, areas that are not "dead but sleeping" can be identified. This phenomenon has

been discussed for many years in stroke patients and authorities have even stated that the critical parameter is not blood flow it is oxygen delivery.⁴ Under normal circumstances, blood flow and oxygen delivery are inextricably coupled, but the use of Hyperbaric conditions can change this situation.

Tissue edema and swelling may persist in, for example, joints, for many years and SPECT imaging has now revealed that this is true in the brain.⁵ What does Hyperbaric mean? It means a pressure greater than normal sea-level atmospheric pressure. Atmospheric pressure at sea level varies with the weather and on a high-pressure day, more oxygen is available to the body. Aches and pains may be worse on a low-pressure day because of the reduction of oxygen pressure. A Hyperbaric chamber allows much more oxygen to be dissolved in the blood. An indication of the power of this technique is that at twice atmospheric pressure breathing pure oxygen the work of the heart is reduced by 20%. So much can be dissolved in the plasma that life is possible for a short time without red blood cells. The research behind the development of Hyperbaric oxygen therapy has been undertaken by doctors involved in aviation, space exploration, and diving. This critical information is not yet taught in our Medical Schools, despite many thousands of published articles including controlled studies in many conditions. Are there dangers? The only risk with hyperbaric conditions properly supervised is to the eardrum, just as when aircraft - which are Hyperbaric chambers - descend. There are limits to oxygen delivery, for example, the very high pressures used in diving can cause convulsions, but the Chinese have shown that epilepsy is actually treated by Hyperbaric oxygen therapy at lower pressures. There is no evidence of either eye or lung toxicity at 1.5-1.75 atm abs.

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