



ProHBOTM
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A person can survive a few days without water, and weeks without food, but if the body is deprived of oxygen, biological death begins to occur within three minutes. The same goes if you deprive just an area of the body of oxygen, such as the brain.

When brain tissue has been damaged due to an injury, a lack of blood flow or a lack of oxygen, the cells that surround the injured area, called the penumbra, may only be receiving a fraction of the blood flow and oxygen they need for optimum health. This disruption creates impairment of cell function. The cells become dormant and may remain permanently impaired.

Hyperbaric Oxygen Therapy (HBOT) for brain injuries is based on the theory that even if brain tissue has been injured, the dormant cells surrounding the injured area can be revived. To do this, the blood supply to the dormant cells needs to be improved.

Flipping On the Switch Using Hyperbaric Oxygen Therapy to treat Brain Injuries

By
Ken G. Knott, M.D. and
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A trained chamber operator is always present during treatments.

A hyperbaric oxygen chamber, in which a patient lies, is pressurized with 100 percent oxygen to greater than atmospheric pressure. While at a typical treatment pressure of 1.5 atmospheres absolute (ATA) (equal to 7.5 psig or 16.88



Case Study II—Mother accompanied the infant during treatment to aide infant with equalization of ears by sucking on a pacifier.



Monoplace chambers are ideal in providing individualized treatments to patients, since different protocols are used on various indications.

feet of sea water) the patient would be breathing an equivalent of 150 percent oxygen or one-and-a-half-times more oxygen molecules in each breath. This will allow the plasma to carry 10 to 15 percent more dissolved oxygen throughout the entire body including areas with decreased blood flow. This is the first step in “flipping on the switch.”

When given daily, HBOT stimulates a process called angiogenesis or the formation of new blood vessels. These new blood vessels form slowly in the vicinity of the damaged tissues, providing more blood flow and oxygen to the dormant cells. This revives the dormant cells and allows them to resume their normal function.

With many brain injuries, edema and hyper-perfusion can be present even for year’s later. In the initial stages, HBOT can reduce this state by vasoconstriction, which decreases blood flow to these areas which in turn allows them to normalize. Simultaneously, an increased percentage of oxygen is being delivered to the tissues.

The result of angiogenesis and vasoconstriction is a permanent structural change in blood supply to the damaged brain tissue and an important contribution to the degree of recovery from the brain injury.

We have seen brain injured patients experience various results as early as the first treatment and even more after 20 treatments. Some patients don’t see anything significant until

a few weeks after their fortieth treatment. So, how many treatments should we initially do? Is some better than none? Well some is better than none and it all depends on the individual case. If a patient is treated early, within 48 hours, one can sometimes evoke a greater response with a lesser number of treatments. However, as the result of many case studies, we know that non-acute patients who have completed an initial set of 40 consecutive HBOT treatments can make positive changes in which the majority, if not all, become permanent.

The reason involves basic physiology. With the increased oxygen in the plasma, the dormant brain cells “turn on” or “awaken” from their dormant state. As function returns, we see clinical changes in the patient. The reason the cells are dormant is due to a lack of blood flow and a corresponding lack of oxygen. So, if the plasma is the only thing delivering the oxygen, and you stop HBOT, then you stop giving those cells the oxygen they need to remain functioning and they become dormant again. Many times these patients do not regress completely but they do lose some of what they may have gained. If a patient completes the full 40 treatments, regression is typically absent and more gains continue for weeks and months after their fortieth HBOT.

It has been shown that capillary budding (growth of blood vessels) can begin as soon as the 8th treatment. The capillary further develops by 20th treatment but it is not completely stable. By 30th to 35th treatment the capillary becomes increasingly stable and by the 40th treatment the new capillary is essentially permanent. This has been proven time and again with non-healing wounds and the salvage of grafts and flaps. HBOT has been stopped prematurely in patients who were showing signs of healing of wounds, grafts or flaps. A few days later, the wound began to deteriorate and the wound, graft or flap fails. Although the histology of the capillaries is different when comparing brain capillaries to those found in other areas of the body, a capillary basically grows the same in the foot as it does in the brain. Physiology is physiology.

Case Study I

Six year old female -

Patient with failure to thrive and resultant cerebral palsy began her first set of hyperbaric treatments in September 2001.

Protocol: 11-HBOT session at 1.6ATA for 90-minutes and 3-HBOT sessions at 1.6ATA for 60 minutes (Equivalent of 20.5 one-hour treatments).

Gains: less moody, calmer, attempted to do puzzles, was able to touch nose, ear, etc. on command.

Regression: less interest in puzzles, more excitable, less awareness.

In July 2002 the patient completed an additional 20 HBOT sessions.

Protocol: 20-HBOT sessions at 1.6ATA for 60 minutes.

Gains: able to complete 20-piece puzzle, attempted to open/close car door, improved school performance, less disruptive, less seizures, improved ability to follow directions, walked with assistance.

Regression: gradual loss of ambulatory skills, more disruptive, less attentiveness to directions or commands, limited interest in puzzles.

In November 2003 she started 40 consecutive HBOT at a new hyperbaric center.

Protocol: 40-HBOT sessions at 1.5ATA for 60 minutes.

Gains: more appropriate response to commands, improved speech pattern (pronunciation), significant behavior change (improved by “70 percent” according to mother), seizure activity diminished, independent play activities improved, speaking in phrases, walking with minimal or no assistance, routine eye contact and virtual completion of toilet training.

No regression.

Upon follow-up of patient 2 months post-HBOT - Gains - integrated into more advanced educational environment, more improvement in speech pattern, a continued ability to engage in play, and a continued ability to ambulate with minimal or no assistance. No regression.

Upon follow-up of patient 6 months post-HBOT no regression.

Initial SPECT scan - October 2003.

Post HBO SPECT scan - January 2004.

SPECT scan difference of Brain Blood Flow (BBF) between pre-HBOT of 40 treatments and post-HBOT: 45 percent global increase of BBF

Impression and Comments: In retrospect, the patient appeared to benefit from the initial HBOT treatment regimen, but regression was noted. The second 20 HBOT treatment regimen also showed a positive response, however regression was again noted. When the patient was given a 40 HBOT treatment regimen, there did not appear to be any regression in any area. There are certainly no guarantees, however, based upon the results seen with this patient, but it does appear that permanent changes are more likely to occur with an isolated 40 treatment program as opposed to an isolated 20 treatment program.

Case Study II:

2-day old male -

Protocol: 5-HBOT sessions at 1.2 ATA for 60 minutes.

After a full term, normal pregnancy, mother experienced a difficult vaginal delivery of a 10 pound -10 ounce boy. The infant's left shoulder became lodged during delivery and the doctor worked for more than four minutes to dislodge the infant's shoulder. Once delivered, the infant cried weakly

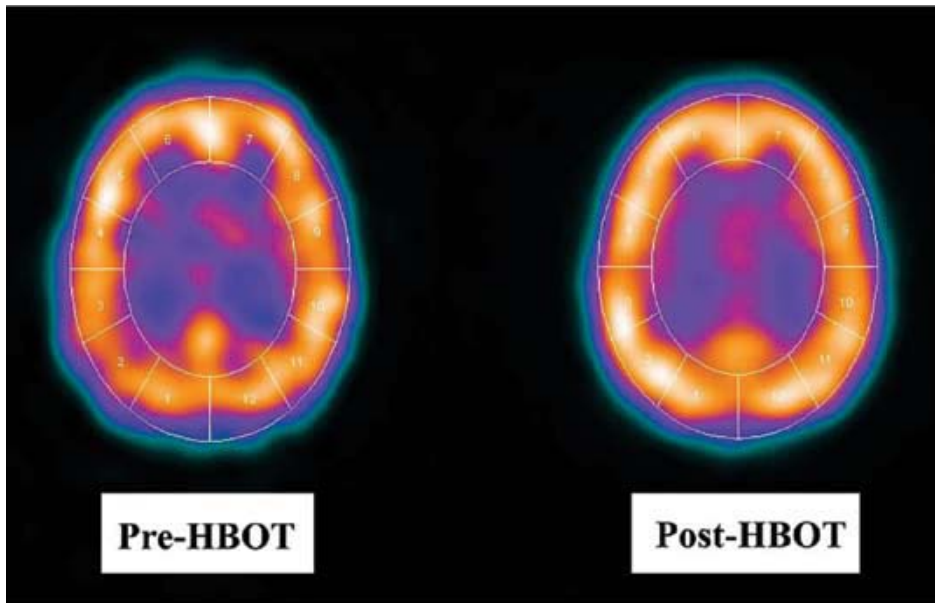
and went into shock. The respiratory department was called stat and worked on the infant for more than three minutes. He subsequently began crying and fully stabilized after 20 minutes. After examination by two different pediatricians, both stated the baby was fine, but no prognosis was offered. The infant was released at 32 hours of age and began hyperbaric oxygen treatment at 40 hours of age.

During the first treatment while in the HBOT chamber, the infant became visibly more alert. After removal from the chamber, the infant exhibited a much stronger vocal response as well as cooing and was much more animated. No additional changes were noted during the next four treatments.

Upon follow-up, the patient reached 95 percent level of growth and development and started walking at 10 months of age.

In addition the mother's back pain resulting from the epidural injection decreased by 80 percent after first treatment and was gone after the second treatment.

Impression and comments: This particular case study is an example of using HBOT in an acute setting to reduce potential neurological problems resulting from oxygen deprivation. It also illustrates the safety of the use of HBOT in young children. Due to the extreme low age of the infant, a pressure of 1.2 ATA was utilized even though 1.5 ATA would have most likely been well tolerated and indicated.



Cerebral Palsy

45% brain blood flow increase globally

SPECT brain blood flow (BBF) image of Case Study I showing a comparison between the Pre-HBOT and Post-HBOT scans which depicts a 45% global increase in BBF. Compliments of Emory University Medical Center.

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Christopher Grant B.S., CHT, EMT-I (left) is the founder and president of Professional Hyperbaric Associates, Inc. (ProHBO), which places and manages HBOT services. He is also the CEO of ProHBO at Health Horizons, Inc. Mr. Grant's career spans over 24 years in the dive industry, 19 years in emergency medical services and 14 years in hyperbaric medicine.

ProHBO at Health Horizons, Inc. is located in Marietta, Georgia and offers HBOT for off-label and labeled indications. For more information, contact ProHBO at Health Horizons by calling 770-421-8094.

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Conclusion:

Unfortunately, HBOT treatment for neurological conditions is not paid for by insurance companies. However, payment policies by insurance companies do not necessarily follow what is medically indicated. The two foregoing case studies illustrate a typical response by patients given the appropriate treatment regimen with HBOT. All patients are different and as a result, no two patients respond equally. However, the vast majority of brain injured patients, particularly those with damage due to reduced amount or lack of oxygen, responds very well to HBOT given at 1.5 ATA for 40 one-hour treatments on either a daily or twice daily basis.

Of course, the question may arise as to whether or not a lesser number of treatments would suffice. It's easy to pick a number, but in our experience, we now know that we are seeing significantly less regression with the 40 treatment regimen as opposed to a 20 treatment program. In addition, we have seen further improvement in many patients who have undergone more HBOT after a break from their initial set of 40 treatments, but 40 seems to be the minimum starting point for non-acute patients. Remember, physiology is physiology.



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