

Hyperbaric Oxygen Treatment

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The mention of hyperbaric treatment to many health professionals will usually result in a blank stare, or the comment that it has something to do with deep-sea diving. Few realize the many clinical and research applications hyperbaric oxygen treatment offers. Several years ago the Center established a hyperbaric oxygen treatment facility (only one of two in this city of 300,000) which is frequently used for clinical treatment and research. Unlike most hyperbaric chambers, our chamber is a custom made, heavy duty type which could be used for decompression treatment, if necessary.

Although hyperbaric treatment is commonly associated with diving applications, clinical use of pressure medicine predated the diving use by more than 200 years. In 1662, Henshaw, a British physician, designed a chamber he called the "domicilium" which used large organ bellows fitted with valves.¹ He could compress the air inside the chamber or remove the air by use of the bellows. Dr. Henshaw used increased pressure to treat acute diseases and reduced pressures to treat chronic diseases. In 1666, Robert Boyle described the behavior of animals in a pressurized environment. In the early part of the 19th century, a pneumatic institute was established at Oxford University for the study of gases and gas mixtures in the treatment of diseases. In 1834, V. T. Junod designed a copper chamber in order to study the physiological and therapeutic action of compression and rarefaction of air on the human body.¹

In 1878, Paul Bert carefully described the mechanisms of oxygen toxicity. Dr. Bert's work was a major turning point in the evolution of diving and clinical hyperbaric medicine.² Others making major contributions to

this field were Norwak (1884)³, Haldane (1907)¹, Cunningham (1920)³, Behnke (1930)¹, and Boerema (1960)⁴.

The mode of action of hyperbaric oxygen (HBO) therapy is that oxygen, inhaled at pressure under hyperbaric conditions, dissolves in the plasma. Up to 6.9 volume percent of oxygen may be forced into the plasma, a quantity sufficient to maintain life in the absence of red blood cells.⁴ The increased oxygen tension in the plasma also stimulates the proliferation of fibroblasts, cells important in neovascularization and wound healing.⁵ HBO stimulates the immune system by enhancing the killing ability of certain white blood cells. White blood cells in a low oxygen environment have a decreased ability to kill ingested micro-organisms. This same killing ability is greatly enhanced by increasing the oxygen tension of the blood.⁶ The increased fibroblastic activity and vascular proliferation from HBO is very important in wound healing, skin grafts, skin flaps and after vascular microsurgery. One immediate effect of HBO is to produce good oxygenation to areas with marginal vascular supply.

This procedure is not only useful in the healing processes but also gives a clear demarcation between areas of proper healing and areas which lack adequate vascular perfusion. This information may prove useful in making subsequent surgical decisions.⁷ Some clinical applications of HBO have been outlined in a report from the Undersea and Hyperbaric Medical Society's "Hyperbaric Oxygen Therapy: A Committee Report."³ Some of these applications are radiation necrosis, gas gangrene, acute carbon monoxide poisoning and acute gas embolism, refractory osteomyelitis, aerobic and anaerobic soft tissue infections, crush injury with traumatic ischemia, compromised skin grafts and refractory mycosis.

Other clinical applications of HBO being used or researched include burn injuries,

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cerebral edema, severe anemia, spinal cord injuries, vascular diseases, T.B. and leprosy, myocardial infarctions, impaired memory function, chronic fatigue, chronic pain, diabetes, cyanide poisoning, stroke, multiple sclerosis and cancer.

Caution must be used with HBO and the patient must be monitored at all times during treatment. HBO has the tendency to constrict blood vessels which could decrease arterial blood flow. However, the tenfold increase of the oxygen content in the plasma would probably compensate for the decreased arterial blood flow.

The treatment protocol at the Center includes a written order from a physician. The treatment is administered by a qualified professional trained in this area. The patient is constantly monitored throughout the treatment. The technician takes the patient through an orientation which discusses the basic sensations experienced in the chamber, methods of equalizing pressures in the ear, the length of treatment time, the option to use a hood or mask for oxygen delivery and any recent illness which could affect the therapy. The technician then explains and has the patient sign a consent form, makes sure any pre-treatment laboratory tests are completed and answers any questions from the patient. The patient then changes into an all cotton scrub suit and removes all jewelry and oil-based make-up.

The patient may make use of a two way communication system to talk with the technician or use a compact disc player or video cassette recorder and television (located outside the chamber) for entertainment during the treatment. The patient gets on a stretcher and is placed into the chamber. The patient then relaxes, breaths oxygen, reads, etc. during the treatment. The patient is always visible to the technician.

The following case histories demonstrate the use of HBO treatment at the Center.

Case #1 The patient is an 80 year old female with complaints of memory deficit. The patient was started on weekly HBO treatments of one hour duration. The first and second treatment depth was at the pressure equivalent of 33 feet. The patient experienced no problems during or after the treatments. The physician then changed the treatment depth to 39 feet. The patient was

given a five minute "air break" after 30 minutes of treatment, then continued with HBO for another 30 minutes. The patient continues with weekly HBO treatments of one hour duration. Results of these treatments based on the observations of the attending physician, patient and patient's husband, are that the patient has "a good energy level, appears sharp and alert, and has no problem with memory loss or confusion." If the patient misses several HBO treatments the husband states that "she starts to have periods of memory loss and confusion and appears to have less energy." Obviously HBO is not a curative therapy in this patient's case, but it appears to improve her quality of life and keeps her ambulatory, active and happy.

Case #2 The patient is a 52 year old obese female with a history of two spider bites to her right ankle. The bites which were on the medial and lateral side of the ankle occurred two and a half years ago. The bite on the lateral side ulcerated and healed with antibiotic therapy. The bite on the medial side has continued to show an inflammatory reaction with constant swelling and redness. It has never ulcerated and has not completely healed 2° years after the bite. Treatment has included continuous antibiotic therapy, steroid cream application, and two weeks of bed rest with leg elevation. The antibiotic therapy had to be discontinued due to G.I. bleeding. The patient complains of pain associated with the bite as "a real hot-burning pain." Laboratory tests at the Center showed numerous nutritional deficits which are now being treated with supplements. History of the patient revealed that this ankle had been fractured eight years ago and still has two screws in place. A series of six HBO sessions were prescribed, one per week for 60 minutes at a pressure of 39 feet.

To date, four treatments have been completed. The extent of the erythema and swelling has decreased dramatically, and the patient describes a "tingling sensation" in the bite area. Photographs were taken before treatment started and will be taken after the last treatment for comparison purposes.

Case #3 This patient is a 46 year old white female diagnosed with Multiple Sclerosis (MS) 15 years ago. She presented with

complaints of weak, stiff legs, numbness in the lower extremities, poor balance, and fatigue. She commented, "I'm not doing so good. My M.S. is re-occurring, and when tired, my left leg drags." A rectal swab performed as part of the physical examination was positive for *Blastocystis hominis* and *Dientamoeba fragilis*. Her CBC differential showed eosinophilia. She was treated with Vermox #6 and instructed to take one a day for three days, skip one week, then repeat. Her repeat examinations were negative for parasites. A trial period of six HBO sessions, two times a week at a pressure of 39 feet for 60 minutes was started. After these first treatments, the patient and staff noticed no real improvement of symptoms, but the patient did state her symptoms were not getting worse. The patient was started on a second series of twenty treatments, one or two per week as her scheduled permitted. At the end of these sessions the patient stated "This is the best I have felt in a long time. My sense of balance is much improved, and my legs feel almost normal."

These three cases only represent some of the applications of HBO used at the Center.

A patient with gangrene of the foot as a result of diabetes has been treated with good results. HBO has been used as an adjunct to other treatments in several patients with different types of cancer. HBO is a treatment option that we find very useful at the Center.

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