Hyperbaric oxygen therapy is no longer considered a "fringe" treatment. The primary mechanism of action of hyperbaric oxygen i.e. enhancement of tissue oxygenation makes this therapy particularly useful for the resolution of hypoxic conditions such as necrotizing fasciitis, gas gangrene/embolism, carbon monoxide poisoning, anemia due to extensive blood loss. Other indications of HBO therapy are: Ch. Non healing wound of >30 days, refractory O.M , Intracranial Abscess & Decompression Syndrome.

Among patients with diabetes up to 70% have some degree of nerve damage, termed diabetic neuropathy. Poor glycemic control, diabetic neuropathy, and peripheral vascular disease, in conjunction with comorbid foot trauma, can result in the formation of a diabetic foot ulcer. Diabetic foot ulcers develop at some point in approximately 15% of patients with diabetes. Sequelae of the ulcers may include infection, gangrene, osteomyelitis, and ultimately amputation. More than half the patients undergoing a lower limb amputation in the United States have diabetes. More than 80% of amputations in patients with diabetes are preceded by trivial DFU.

Diabetic foot ulcers are associated with significant morbidity and mortality. The risk of death is 2.4 times greater for patients with diabetes who have foot ulcers than for patients with diabetes who do not. Further, diabetic foot complications are the most frequent cause of hospitalization in patients with diabetes, accounting for up to 25% of all admissions among patients with diabetes. The goals of therapy include improvement in function, infection control, and avoidance of amputation.

Principles of Hyperbaric Oxygen Therapy

In hyperbaric oxygen therapy, patients breathing 100% oxygen are placed in a chamber pressurized to 2 to 3 times atmospheric pressure. This pressure is equivalent to diving to approximately 15 m (50 ft) in seawater. Hyperbaric Oxygen Therapy Increases tissue oxygen tension, fibroblast proliferation, angiogenesis & collagen deposition and it enhances bacterial killing too. In use since 1943,
Hyperbaric oxygen therapy is considered the treatment of choice for decompression sickness and severe carbon monoxide poisoning.

Two systems for hyperbaric oxygen therapy are currently available: monoplace and multiplace chambers. In each instance, patients breathe pure oxygen while exposed to barometric pressures greater than normal atmospheric pressure. Monoplace chambers are hollow cylinders compressed with pure oxygen that allow 1 patient to lie supine during hyperbaric therapy. Multiplace chambers accommodate up to 6 patients at once; each patient is given an individual breathing source of 100% oxygen via a hood or mask. Hyperbaric oxygen given in this manner, often referred to as systemic hyperbaric oxygen therapy, should not be confused with topical oxygen therapy or pure oxygen inhaled at ambient atmospheric pressure.

**Clinical Trials**

Several studies have been done till date to assess the effectiveness of hyperbaric oxygen therapy in the treatment of 989 patients with diabetic foot ulcers. In all cases, hyperbaric oxygen therapy was used as an adjunct to standard wound care.

When all the trials that used foot amputation as a primary outcome variable are considered, amputation was prevented in from 82% to 95% of patients in the groups receiving hyperbaric treatment. When data from all controlled trials (both retrospective and prospective) are combined and averaged, hyperbaric oxygen therapy resulted in a mean limb salvage rate of 89%, compared with prevention of amputation in 61% of patients who received conventional therapy alone. This difference translates to a relative risk reduction of 0.74 attributable to hyperbaric oxygen therapy. In other words, the patients with diabetes in these studies who underwent adjunctive hyperbaric treatment had approximately one fourth the risk of limb amputation compared with the patients who received conventional therapy only.
Despite limitations in the power of the studies because of the relatively small sample sizes in most instances, hyperbaric oxygen treatment resulted in a significant reduction in amputation rates in all comparative trials. Thus, adjunctive hyperbaric oxygen therapy is superior to conventional ulcer therapy. However, most of the patients studied in these trials had necrotic foot ulcers that were refractory to standard therapy. Also, most of the subjects had ulcers that were primarily ischemic. These facts limit the applicability of these results to those patients with diabetes who have ischemic ulcers complicated by profound peripheral vascular disease. Whether hyperbaric oxygen therapy will be as effective in patients with diabetes who have foot lesions that are predominantly neuropathic remains to be determined.

**Safety**

Absolute contraindications to hyperbaric oxygen therapy include untreated pneumothorax and treatment with certain chemotherapeutic agents (doxorubicin, bleomycin, and cisplatin) or disulfiram. Relative contraindications include seizure disorders, emphysema, upper respiratory tract infections, and a history of thoracic surgery, spontaneous pneumothorax, or surgery for otosclerosis.

In general, if pressures do not exceed 3 atm ($3.04 \times 10^5$ Pa) and the length of therapy is less than 2 hours, hyperbaric oxygen therapy is considered safe. Other than pressure on the ears (easily managed by decongestants, yawning, or the Valsalva maneuver), the most common adverse effect is a reversible nearsightedness. Myopia associated with hyperbaric therapy usually resolves completely approximately 6 weeks after discontinuation of the therapy. The remaining adverse effects are rare; these may include ear, sinus, or tooth pain from changing pressures of gases in the chamber, an occasional dry cough, a temporary burning sensation under the sternum, and feelings of claustrophobia related to being in a restricted space. A very slight increase in seizure risk has been noted, particularly in patients with a high fever or history of epilepsy.

**Cost**

Hyperbaric oxygen therapy is expensive. However, this expense should be viewed in light of the total costs associated with therapeutic failure: the costs for osteomyelitis, amputation, and subsequent rehabilitation.

**Conclusion**

Hypoxia can cause otherwise trivial DFU to progress rapidly to infection, gangrene, and limb amputation. Hyperbaric oxygen therapy increases the amount of oxygen dissolved in the plasma, allowing tissues to achieve levels of oxygenation that would otherwise be impossible.

Hyperbaric oxygen therapy is adjunctive treatment and will never replace good wound care. The American Diabetes Association recommends hyperbaric oxygen therapy as adjunctive treatment for severe and limb- or life-threatening wounds unresponsive to other treatments, particularly if ischemia is present that cannot be corrected by vascular surgery. A review of the available literature reveals that the mean limb salvage rate is 89% after hyperbaric oxygen therapy, compared with 61% after conventional treatment.
References


