

Hyperbaric Oxygen Therapy: A New Era in Dentistry

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ABSTRACT

Hyperbaric oxygen therapy is a rapidly developing treatment modality in various fields of dentistry. Hyperbaric oxygen therapy (HBOT) includes therapeutic administration of 100% oxygen under pressure, which has a deleterious effect on anaerobic microorganisms responsible for periodontal diseases. This review article focuses on the historical background, mechanism of action, applications & contraindications in the field of dentistry.

Key words: Hyperbaric oxygen therapy, periodontitis, osteoradionecrosis.

INTRODUCTION

HYPER” means increased and “BARIC” means pressure. Hyperbaric oxygen (HBO) therapy is defined as inhalation of oxygen at increased pressure, for potential therapeutic benefit in a variety of clinical situations. The Committee of Hyperbaric Medicine defines HBO therapy as “A mode of medical treatment in which the patient is entirely enclosed in a pressure chamber and breathes 100% oxygen at a pressure >1 atmosphere absolute (ATA).” ATA is the unit of pressure and 1 ATA is equal to 760 mm of mercury or pressure at sea level. ^[1] The concept of hyperbaric oxygen therapy can be traced back to 1600, but as a therapy, HBO began to be given in 1943. Since 1967, hyperbaric oxygen with 100% oxygen, beginning at 2.8 ATA, has been the world’s standard for the treatment of decompression sickness among military and commercial divers and aviators. ^[2]

Types of Chamber

HBO therapy is administered in a hyperbaric chamber. They are of two basic types: ^[3]

1. Monoplace chambers:

- Transparent
- Made up of acrylic
- Can accommodate a single patient and the patient does not require a mask.
- Capability of 3.0 ATA and compressed with 100% oxygen.

Advantages:

- a. Cost & space requirement is less.
- b. No risk of decompression sickness.

Disadvantages:

- a. Relative patient isolation.
- b. Associated fire hazard.
- c. Inability to use certain diagnostic and/or therapeutic equipment.

2. Multiplace chambers:

- Usually of steel
- Can accommodate more than two people
- Pressurized with air while the patients breathe O₂ from a tight fitting mask/circuit.

Advantages:

- a. Constant patient attendance and evaluation
- b. Greater working pressure.

Disadvantages:

- a. Higher capitalization requirements.
- b. Major space requirements.
- c. Higher operating costs.

Applications in Dentistry

In dentistry, hyperbaric oxygen therapy is used in:

- Osteoradionecrosis
- Osteomyelitis of jaws
- Aggressive periodontitis
- Adjunctive therapy for the placement of the implants in irradiated jaws.

Mechanism of HBOT in the Treatment of Periodontitis

HBOT showed to increase oxygen distribution at the base of the pocket which is deleterious to periodontal pathogens, particularly to the anaerobic microorganisms. [4] Cultivation of plaque microorganisms from sites of chronic periodontitis reveals high percentages of anaerobic (90%) bacterial species. [5] HBO2 increases generation of oxygen free radicals, which oxidize proteins and membrane lipids, damaged oxyribonucleic acid and inhibit bacterial metabolic functions. It also facilitates the oxygen-dependent peroxidase system by which leukocytes kill bacteria. HBO2 also improves the oxygen-dependent transport of certain antibiotics across bacterial cell walls. [6] In this way HBOT results in inhibition of bacterial growth.

HBOT would also allow the ischemic tissues to receive an adequate intake of oxygen sufficient for a rapid recovery of cell metabolism. [4] Oxygen tension in periodontal pockets is very low (pO₂ 5-27 mmHg) when compared with atmospheric pO₂ (155 mmHg), the arterial blood pO₂ (95 mmHg), and the venous blood pO₂ (20-40 mmHg). [7] Fibroblast and leukocyte function are severely compromised when pO₂ is less or equal to 30 mmHg. HBO2 increases collagen formation for capillary growth. HBO2 also promotes fibroblast replication and collagen formation while the patient is in the hyperbaric chamber. [8, 9] It also increases bactericidal function of leukocytes. HBOT also improve gingival microcirculation and increase gingival blood flow. [10]

Thus in periodontal tissues, HBOT showed to have a deleterious effect on periodontal microorganisms as well as beneficial effects on periodontal healing by raising oxygen tension in pocket.

Other applications:

According to the Undersea Hyperbaric Medical Society, [11] the approved indications of hyperbaric oxygen therapy are

1. Air or Gas Embolism
2. Carbon Monoxide Poisoning Complicated by Cyanide Poisoning
3. Clostridial Myositis and Myonecrosis (Gas Gangrene)
4. Crush Injuries, Compartment Syndrome and Other Acute Traumatic Ischaemia
5. Decompression Sickness
6. Arterial Insufficiencies
7. Severe Anaemia
8. Intracranial Abscesses
9. Necrotizing Soft Tissue Infections
10. Osteomyelitis (Refractory)
11. Delayed Radiation Injuries (Soft Tissue and Bony Necrosis)
12. Compromised Grafts and Flaps
13. Acute Thermal Burn Injuries

★ Contraindications

The various contraindications of hyperbaric oxygen therapy [12] are:

Absolute contraindications:

1. Untreated tension pneumothorax

Relative contraindications:

1. Upper restrictive tract infections
2. Emphysema with carbon dioxide retentions
3. Asymptomatic pulmonary lesions which are seen on chest X-ray
4. History of thoracic or ear surgery
5. Uncontrolled hyperthermia
6. Pregnancy
7. Claustrophobia
8. Seizure disorder

POTENTIAL COMPLICATIONS OF HYPERBARIC OXYGEN THERAPY

1. Oxygen toxicity - Seizures, dry cough, chest pain or burning. [13]
2. Visual refraction changes - Cataract, progressive myopia with prolonged number of treatments.
3. Barotrauma - In ears, sinus, lungs, tooth caries/fillings.

CONCLUSION

Hyperbaric oxygen therapy can be used as an adjunct to conventional procedure to treat periodontitis as HBOT has improved gingival blood flow and microcirculation, inhibited the growth of periodontal pathogens in periodontal pocket.

Although HBOT has side-effects, most specialists in the field consider the risk profile for patients acceptable when treating the conditions for which HBO₂ is clearly indicated.

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