

## Clinical Applications of Ozone Therapy

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### Abstract:

Ozone therapy is conventional form of medicine that has been used in medical field for various diseases for more than 100 years. Ozone therapy is multipurpose therapy having its unique properties, non-invasiveness, absence of side effects or adverse reactions which is responsible for its wide range of biological actions such as Anti-Microbial action, Anti-inflammatory actions, Immune stimulating action, Anti-hypoxic action, Bioenergetics and biosynthetic Action etc. Ozone can produce biological actions according to the chosen concentration and route of its administration. This review of literature provides its therapeutic potential in many diseases and its clinical applications in future.

**Key Words:** Ozone therapy, Clinical applications, Economical, Less side effects.

### Introduction:

The word ozone is derived from the Greek word —ozein meaning odorant in 1840 by Schonbein. Ozone has a long history in research and clinical applications. Ozone therapy has been used for over 130 years in twenty countries throughout the world and accepted as an alternative medicine in the USA from 1880 and During World War I, ozone gas was used for treating gaseous post-traumatic gangrene, infected wounds, mustard gas burns and fistulas in German soldiers. Dr. E.A. Fisch was the first dentist to use ozone in his practice in the 1930s. Ozone therapy can be defined as a multipurpose bio-oxidative therapy in which ozone is administered via gas or dissolved in water or oil base to obtain therapeutic benefits<sup>(4)</sup>. Ozone also known as triatomic oxygen and trioxxygen is a naturally occurring compound consisting of three oxygen atoms<sup>(1)</sup>. Ozone is highly reactive chemical element. It is constantly formed as a colourless gas. Ozone has a molecular weight about 47.98 g/mol<sup>(6)</sup>.

Ozone is thermodynamically unstable molecule which, depending upon conditions such as temperature and pressure. Its half-life is 40 min at 20°C and about 140 min at 0°C. Its basic function is to protect humans from harmful effects of UV radiation. Ozone occurs naturally at less than 20 µg/ml from the Earth's surface, at concentrations that are perfectly compatible with life<sup>(5)</sup>. Medical ozone is made when medical grade oxygen is electrically activated (using Ozone generator) to form ozone. Medical grade Ozone is a mixture of pure O<sub>2</sub> and pure O<sub>3</sub> in the ratio of 0.1% to 0.5% of O<sub>3</sub> and 95- 99.5% of O<sub>2</sub>. The Ozone concentration may vary between 1 and 100 µg/ml (0.05-5%). Ozone gas has a high oxidation potential and is 1.5 times greater than chloride when used as an antimicrobial agent against bacteria, viruses, fungi and protozoa<sup>(7)</sup>.

### Goals:-<sup>(8)(9)</sup>

- To eliminate pathogens.<sup>(9)</sup>
- To restore proper oxygen metabolism.<sup>(9)</sup>
- To induce friendly ecologic environment.<sup>(9)</sup>
- To increase blood circulation.<sup>(8)</sup>
- To activate immune system.<sup>(8)</sup>
- To activate humoral antioxidant system.<sup>(8)</sup>

### Routes of Administration:-<sup>(8)</sup>

Ozone can be available in following forms:

#### ● Gaseous ozone:-

Ozone can be used in gaseous form via an open system or via a sealing suction system to avoid inhalation and its adverse effects.

#### ● Ozonated Water:-

Ozonated water has been shown to be very effective against bacteria, fungi and viruses.

#### ● Ozonized Oil:-

In addition to gaseous and aqueous form, oils that are ozonized also seems extremely convenient.

### Clinical Application of Ozone Therapy:-

#### Antimicrobial:-<sup>(1)(3)(9)(13)</sup>

Ozone works destructively against bacteria, fungi and viruses. The antimicrobial effect of ozone is a result of its action on cells by damaging its cytoplasmic membrane due to ozonolysis of dual bonds and also ozone-induced modification of intracellular contents because of secondary oxidant effects<sup>(13)</sup>. When applied externally in a form of gaseous mixture or in ozonated solution it is recommended to use high ozone concentrations which produce direct oxidative effect on the microorganism membrane<sup>(1)</sup>. Ozone

can destroy practically all kinds of bacteria, viruses, fungi and protozoa. Gram-positive bacteria and capsular viruses having a lipid bio-layer are particularly sensitive to oxidation<sup>(9)</sup>. The use of therapeutic ozone concentrations provides bactericidal effect which indirectly activates the non-specific defense system (phagocytosis activation, enhanced synthesis of cytokines-interferons, interleukin tumor necrotic factor) as well as components of cellular and humoral immunity<sup>(3)</sup>.

### Anti-inflammatory:-<sup>(3)(6)</sup>

Anti-inflammatory effect is revealed in ozone capacity to oxidize the compounds containing double bonds, the arachidonic acid (20:4) and its derivatives - prostaglandins, in particular. These biologically active substances participate in the development and sustaining the inflammatory process. Besides, ozone regulates metabolic reactions in tissues at the place of inflammation and resolves pH<sup>(3)</sup>. Ozone therapy efficiency in bronchial asthma can be partially explained by oxidation of double bonds in such pathological compounds as leukotriens also derived from arachidonic acid<sup>(6)</sup>.

### Analgesic:-<sup>(3)</sup>

Ozone analgesic effect is provided by oxidation of the products of albuminolysis, the so-called allopeptides. They act on the nerve endings in the damaged tissue and determine the intensity of pain response. To add to that, analgesic effect is also caused by normalization of antioxidant system and accordingly, by the decrease in the amount of toxic molecular products of lipid peroxidation on cellular membranes, that modify the function of membrane-inbuilt enzymes, which participate in ATP synthesis and in maintaining the vital activity of organs and tissues.

### Immuno stimulating action:-<sup>(3)(10)</sup>

Ozone immune-modulating effect is based on its interaction with lipid structures of cellular membranes and depends on the chosen dose. Low ozone concentrations promote the accumulation of ozonides on the membranes of phagocytic cells – monocytes and macrophages. Due to ozonides these cells stimulate the cytokines synthesis of different classes<sup>(3)</sup>. Cytokines being biologically active peptides contribute to the further activation of non-specific defence system (elevation of body temperature, generation of acute-phase peptides in the liver) and, apart from it, they activate cellular and humoral immunity. All together they facilitate the treatment of secondary immune-deficiency<sup>(10)</sup>.

### A. In Dentistry:-<sup>(1)(2)(10)</sup>

#### Management in Caries and Plaque biofilm:-

Ozone has a severely disruptive effect on cariogenic bacteria, resulting in elimination of acidogenic bacteria. The strongest naturally occurring acid, produced by acidogenic bacteria during carcinogenesis is pyruvic acid. Ozone can

decarboxylate this acid to acetic acid<sup>(4)</sup>. It has been shown that remineralisation of carious lesions can be encouraged when the production of acetic acid, or other high pKa acids found in resting plaque, buffers plaque fluid<sup>(2)</sup>. Ozonated water is effective in killing gram-positive, gram-negative bacteria and oral *Candida albicans* causing periodontal disease.<sup>(10)</sup>

### ● Management of hypersensitivity:-<sup>(2)</sup>

Smear layer present over the exposed root surface prevents the penetration of calcium and fluoride ions deep into the dentinal tubules. Ozone removes this smear layer, opens up the dentinal tubules, broadens their diameter and allows the Calcium and Fluoride ions to flow into the tubules easily, deeply and effectively to plug the dentinal tubules, preventing the fluid exchange through these tubules. Thus, ozone can effectively reduce the root sensitivity problem immediately.

### ● Management in Endodontic :-<sup>(2)</sup>

Microorganisms are one of the causes in the failure of root canal therapy. Ozone is one of the most powerful antimicrobial agents with enormous advantages to reduce the number of microorganisms in the root canal. Studies have proved the potential use of ozone gas, ozonated water and ozonised oil in endodontic therapy.

### Anti-cancer:-<sup>(3)</sup>

Cancer cells are anaerobic in nature, when they exposed to oxygen they die so ozone therapy is very effective to treat cancer.

### Anti-hypoxic:-<sup>(10)</sup>

Ozone improves the transportation of oxygen in blood, which results in change of cellular metabolism activation of aerobic processes (glycol sis, Krebs cycle,  $\beta$ -oxidation of fatty acids) and use of energetic resources. Ozone improves the metabolism of inflamed tissues by increasing their oxygenation and reducing total inflammatory processes.

### Advantages:-<sup>(7)</sup>

The following are advantages for the use of Ozone therapy:

- It is painless procedure.
- It is economical.
- It improves regional circulation.
- It stimulates regenerative procedures.
- It activates intracellular metabolism of oral mucosa and dental wounds.
- Haemostasis in capillary bleedings.

### Disadvantages:-<sup>(7)</sup>

The following are disadvantages for the use of Ozone Therapy:-

- Ozone toxicity may occur if the level increases at 0.0007% per application.
- It is instable.
- Not readily available.

#### Contraindications:-<sup>(1)(8)</sup>

The following are contraindications for the use of ozone therapy:

- Pregnancy- To avoid mutagenic risk.<sup>(4)</sup>
- Severe anaemia
- Hyperthyroidism
- Thrombocytopenia
- Cardiovascular Instability
- Patients on ACE inhibitors.

#### Discussion:

Ozone therapy is a form of alternative medicines that purpose to increase the amount of oxygen in the body through the introduction of ozone. Ozone therapy allows a new vision, which complies with needs and demands of the public for non-invasive, effective therapy. The ozone therapy has been more beneficial than any other present conventional therapeutic modalities with great benefits to the patients. This therapy has been proposed for use of diseases like cancer, dentistry, used as antimicrobial, anti-inflammatory, analgesic, anti-hypoxic. It disinfects the tissues treated and leaves no toxic residues like chlorinated products. In potent antimicrobial comparison with other treatment modality, ozone therapy is quite inexpensive with less time consuming. The potent antimicrobial of ozone makes it a therapeutic agent of choice in the treatment of infectious oral diseases. There is still a need for the highest level of evidence which is well designed; to justify the use of ozone as a treatment modality in dentistry. Further research is needed to standardize treatment procedures of ozone therapy.

#### Conclusion:

Ozone therapy has a wide range of applications in almost every biological field. In contrast with traditional medicines and modalities such as antibiotics and disinfectants, ozone therapy is quite inexpensive, predictable and conservative. Its unique properties include immunostimulant, analgesic, anti-inflammatory, antimicrobial, detoxicating etc. It has fewer side effects as compare to other type of therapy. It is atraumatic, painless, non-invasive in nature and relative absence of discomfort and due to these properties patient's acceptability and compliance increases and making it an ideal treatment choice specially for paediatric patients.

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