OZONE THERAPY – AN EMERGING PROSPECTUS IN PERIODONTICS

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Abstract-

Gingival and Periodontal diseases represent a major concern both in dentistry and medicine. Periodontitis is a destructive inflammatory disease of the supporting tissues of the teeth and is caused either by specific microorganisms or by a group of specific microorganisms, resulting in progressive destruction of periodontal ligament and alveolar bone with periodontal pocket formation, gingival recession, or both. The majority of the contributing factors and causes in the etiology of these diseases are reduced or treated with ozone in all its application forms (gas, water, oil).Ozone- a triatomic highly oxidizing agent, its bactericide, virucide and fungicide effects are based on its strong oxidation effect with the formation of free radicals as well as its direct destruction of almost all microorganisms. Ozone has wide application in dentistry which includes treatment of carious lesions, root canal disinfection, wound healing impairments after surgical interventions, plaque control, disinfection of dentures etc. The objective of this article is to provide an overview of the clinical applications of ozone in periodontics.

Key Words – Gingivitis, Periodontitis, ozone therapy

Introduction-

Ozone (O3) is a triatomic molecule, consisting of three oxygen atoms. Its molecular weight is 47,98 g/mol[1]. Ozone is thermodynamically highly instable compound that, depending on system conditions like temperature and pressure, decomposes to pure oxygen with a short half-life[2]. Ground-level ozone is an air pollutant with harmful effects on the respiratory system. Ozone in the upper atmosphere filters potentially damaging ultraviolet light from reaching the Earth's surface. It has many different applications in various fields; one of them is usage of ozone in medicine[3]. Ozone therapy is one of the modern non-medication methods of treatment. It is being used for more than 100 years.

Medical reports on successful application of ozone in therapy of different diseases and studies of its effects caused a rapid growing interest in it. Some other factors were responsible for its wide spreading use, such as simplicity of performance, good tolerance by patients, absence of side-effects or adverse reactions and high medical-social and economic efficiency. Even though ozone therapy is still being ignored by most of medical establishment because of facts that gaseous ozone is quite toxic and has strong oxidative properties[4]. The word ozone was first used by Schonbein in 1840. He subjected oxygen to electrical discharges and noted "the odour of electrical matter". Schonbein concluded that odour was due to a gas which he named ozone, from the Greek ozein (odorant), and described several of its properties. Numerous researchers since that time have worked to elucidate the nature and actions of ozone. MariniakandDelarive showed that it is an allotropic form of oxygen, and Mulliken and Dewar clarified its molecular architecture.

There are some reports in which Ozone therapy has been effectively used in treating periodontal diseases (Nagayoshi, Huth) [19, 20]

History-

First discovered until 1840 by the German chemist Christian Frederick Schonbein at the University of Basil in Switzerland, ozone was first used in medicine in 1870 by Landler. However, it was not until 1932, that ozone was seriously studied by the scientific community, when ozonated water was used as a

disinfectant by Dr. E. A. Fisch[5] a Swiss dentist. Fisch had the first idea to use ozone as either a gas or ozonated water in his practice. By a twist of fate, a surgeon, Dr. E Payr (1871– 1946) had to be treated for a gangrenous pulpite and remained astonished by the result achieved with local ozone treatment. He enthusiastically extended its application to general surgery.

At the time, ozone therapy was difficult and limited due to the lack of ozone-resistant materials, such as Nylon, Dacron, and Teflon, until 1950 when ozone- resistant materials were manufactured. At that time Joachim Hänsler, a German physicist and physician, joined another German physician, Hans Wolff, to develop the first ozone generator for medical use. Their design continues to be the basis for modern equipment.

Ozone generators

There are three different systems for generating ozone gas[6]:

- Ultraviolet System: produces low concentrations of ozone, used in esthetics, saunas, and for air purification.
- Cold Plasma System: used in air and water purification.
- Corona Discharge System: produces high concentrations of ozone. It is the most common system used in the medical/ dental field. It is easy to handle and it has a controlled ozone production rate. Medical grade ozone is a mixture of pure oxygen and pure ozone in the ratio of 0.05% to 5% of O3 and 95% to 99.95% of O2. Due to the instability of the O3 molecule, medical grade ozone must be prepared immediately before use. Within less than an hour after preparation only half of the mixture is still ozone while the other half is transformed into oxygen. As a result, it is impossible to store ozone over long periods of time. In order to control the decomposition of O3 into oxygen it can be associated with a vehicle with aqueous properties to promote the conversion more quickly or with a vehicle with more viscous properties to retard the conversion.

Mechanism of action

The physio-chemical properties of ozone are accredited for its application in Periodontics. Its known actions on human body are antimicrobial, analgesic, Immunostimulating, antihypoxic and biosynthetic.[7]

Anti microbial effect:

It is known that ozone can kill bacteria by rupturing their cell membranes within a few seconds. In medicine and dentistry, ozone is used as a powerful sterilizing agent either in the gaseous or aqueous phase, as it successfully kills bacteria, fungi and viruses. Ozone has been found to have a bactericidal effect, particularly in staphylococcal, streptococcal and other infections.[8]

Immunostimulating effect:

Ozone influences cellular and humoral immune system. It stimulates proliferation of immunocompetent cells and synthesis of immunoglobulins. It also activates function of macrophages and increases sensitivity of microorganisms to phagocytosis. Ozone causes the synthesis of biologically active substances such as interleukins, leukotrienes, and prostaglandins which is beneficial in reducing inflammation and wound healing.[9]

Antihypoxic effect:

Ozone improves the transportation of oxygen in blood, which results in change of cellular metabolism activation of aerobic processes and use of energetic resources. Ozone improves the metabolism of inflamed tissues by increasing their oxygenation and reducing total inflammatory processes.[9]

Biosynthetic effect:

It activates mechanisms of protein synthesis increases amount of ribosomes and mitochondria in the cells. These changes on the cellular level explain elevation of functional activity and regeneration potential of tissues and organs.[9]

Medical grade ozone

It is a mixture of pure oxygen and pure ozone in the ratio of 0.05% to 5% of O3 and 95% to 99.95% of O2. Due to the instability of the O3 molecule, medical grade ozone must be prepared immediately before use. Within less than an hour after preparation only half of the mixture is still ozone while the other half is transformed into oxygen. As a result, it is impossible to store ozone over long periods of time. In order to control the decomposition of O3 into oxygen it can be associated with a vehicle with aqueous properties to promote the conversion more quickly or with a vehicle with more viscous properties to retard the conversion.[10]

Goals of ozone therapy

Setting the standard-of-care and therapeutic goals are based on sound evidence-based science is critical.

Therapeutic goals are inclusive and not exclusive of standard of care.

The goals of oxygen/ozone therapy are[11]:

1. Elimination of pathogens.
2. Restoration of proper oxygen metabolism.
3. Induction of a friendly ecologic environment.
4. Increased circulation.
5. Immune activation.
6. Simulation of the humoral anti-oxidant system

Forms of ozone used for administration

1. Gaseous Ozone -

Gaseous ozone is most frequently used in restorative dentistry and endodontics. Topical administration of the gaseous form can be via an open system or via a sealing suction system as a prerequisite to avoid inhalation and adverse effects. Ozone appears to be an integral part of noninvasive therapy of dental caries, as a disinfectant prior to placing a direct restoration and as therapy for hypomineralized teeth.[12]

2. Ozonated Water–

Ozonated water has been shown to be very effective against bacteria, fungi and viruses and is also less expensive compared to other chemical cleaners. Gaseous ozone was shown to be a more effective microbicide than the aqueous form and, applied for 3 min, may be used as a dental disinfectant.[13] Because ozone gas has been found to have toxic effects if inhaled into the respiratory tract, [12,13,14]ozonated water may be useful to control oral infections and various pathogens.[15]

3. Ozonized Oil–

In addition to ozone application in its gaseous and aqueous form, sunflower ozonized oil also seems extremely convenient. The wide accessibility of sunflower oil makes it a competitive antimicrobial agent. Ozonized oil (Oleozone, Bioperoxoil) has shown to be effective against Staphylococci, Streptococci, Enterococci, Pseudomonas, Escherichia coli and especially Mycobacteria [12,16,22] and has been utilized for the cure of fungal infections. [12, 16]

Use in dentistry -

1. Intreatment of Gingivitis, Periodontits, Periimplantitis, Surgical cuts, Caries, Enamel cracks, Root canal treatment, Tooth whitening, Dentinal hypersensitivity, Abscess, Granuloma, Fistulae, Apthae, Herpes infection, Stomatitis – Candidiasis Surgery-Implantation, Re-plantation, Extraction, Wound Healing, Coaguloapathy – prolonged bleeding, Stumps and crown disinfection, Cavity disinfection, TMJ dysfunctions, Trismus, Relaxation, Myoarthtopathy,Vitality test.

Ozone Therapy:
Potential Applications in Periodontal Therapy

Periodontitis is chronic gingivitis with associated loss of attachment. The development and course of periodontitis appears to be dependent upon specific inherited, behavioural or environmental conditions—so called risk factors and certain risk determinants (genetics, socioeconomic

status and gender).[18] It is a multifactorial disease process in the mouth. The role of microorganisms, host response, in the etiology of periodontal disease is well established. The undisputed disinfection power of ozone over other antiseptics makes the use of ozone in treatment of periodontitis a very good alternative and/or an additional disinfectant to standard antiseptics.

Ozone in various formscan be used for treatment of periodontal disease: ozonated water, ozonized olive oil and gaseous ozone.[19]Thanomsub et al. 2002 tested the effects of ozone treatment on cell growth and ultra- structural changes in bacteria (Escherichia coli, Salmonella sp., Staphylococcus aureus and Bacillus subtilis). It was discovered that ozone at 0.167 mg/min/l can be used to sterilize water, which is contaminated with up to 105 cfu/ml bacteria within 30 min. Destruction of bacterial cell membrane was observed, subsequently producing intercellular leakage and eventually causing cell lysis.[19,20]Ozonated water (4 mg/l) was found effective for killing gram-positive and gram-negative oral microorganisms and oral Candida albicans in pure culture as well as bacteria in plaque biofilm and therefore might be useful as a mouth rinse to control oral infectious microorganisms in dental plaque. In implant dentistry, the use of ozone is currently being investigated for the decontamination of the implant surface in Peri-implant therapy.[19]Nagayoshi et al. examined the effect of ozonated water on oral microorganisms and dental plaque. Dental plaque samples were treated with 4mL of ozonated water for 10 s. they observed that ozonated water was effective for killing gram-positive and gram-negative oral microorganisms and oral Candida Albicans in pure culture as well as bacteria in plaque biofilm and therefore might be useful to control oral infectious microorganisms in dental plaque.[21]Huth et al. in 2006, in their study declared that the aqueous form of ozone, as a potential antiseptic agent, showed less cytotoxicity than gaseous ozone or established anti microbials (chlorhexidinedigluconate [CHX]: 2%, 0.2%; sodium hypochlorite 5.25%, 2.25%; hydrogen peroxide- H2 O2 3%) under most conditions. Therefore, aqueous ozone fulfills optimal cell biological characteristics in terms of biocompatibility for oral application.[19,22]

Kronusova 2007 used ozone in following cases: Prevention of dental caries in fissures of the first permanent molars in children, application of ozone in prepared cavity, after tooth extraction, in case of post extractional complications, in patients with chronic gingivitis, periodontitis and periodontal abscesses, herpes labialis, purulent periodontitis, dentition difficilis, etc., Almost all patients with gingivitis showed subjective and objective improvement of their status, as well as patients with periodontal abscess, where no exudation was observed. Application of ozone after tooth extraction was found also quite useful - only 10% of patients suffered from such complication as alveolitissicca, but even in these cases the clinical course was shorter and more moderate.[19,23]

Huth, et al. in 2011 compared the effectiveness of ozone with that of the established antiseptic CHX, against periodontal microorganisms. There were no significant differences in the effectiveness of aqueous ozone (20 µg ml [−1]) or gaseous ozone (≥4 g [−3]) compared with 2% CHX but they were more effective than 0.2% CHX. Therefore, high-concentrated gaseous and aqueous ozone merit further investigation as antiseptics in periodontitis therapy.[19,24]

Kshitish and Laxman[25]conducted a randomized, double-blind, crossover split-mouth study on 16 patients suffering from generalized chronic periodontitis. The study period of 18 days was divided into two time-intervals, i.e. baseline (0 days) to 7th day, with a washout period of 4 days followed by a second time interval of 7 days. Subgingival irrigation of each half of the mouth with either ozone or chlorhexidine was done at different time intervals. They observed a higher percentage of reduction in plaque index (12%), gingival index (29%) and bleeding index (26%) using ozone irrigation as compared to chlorhexidine. The percentile reduction of Aa (25%) using ozone was appreciable as compared to no change in Aa occurrence using chlorhexidine. By using O3 and chlorhexidine, there was no antibacterial effect on Porphyromonasgingivalis (Pg) and Tannerellaforsythensis. The antifungal effect of ozone from baseline (37%) to 7th day (12.5%) was pronounced during the study period, unlike CHX, which did not demonstrate any antifungal effect. No antiviral property of ozone was observed. The antiviral

efficacy of chlorhexidine was better than that of ozone. They concluded that despite the substantivity of chlorhexidine, the single irrigation of ozone is quite effective to inactivate microorganisms.

Ozone toxicity -

Ozone inhalation can be toxic to the pulmonary system and other organs. Complications caused by ozone therapy are infrequent at 0.0007 per application. Known side-effects are epiphora, upper respiratory irritation, rhinitis, cough, headache, occasional nausea, vomiting, shortness of breath, blood vessel swelling, poor circulation, heart problems and at a times stroke.[26]Because of ozone's high oxidative power, all materials that come in contact with the gas must be ozone resistant, such as glass, silicon, and Teflon. However, in the event of ozone intoxication, the patient must be placed in the supine position, and treated with vitamin E and n- acetylcysteine.

Contraindications [27]-

Pregnancy,Glucose-6-phosphate-dehydrogenase deficiency (Favism),Hyperthyroidis, Severe anaemia, Severe myasthenia,Active haemorrhage, Acute alcohol intoxication&Recent Myocardial infarction

Conclusion-

In contrast with traditional medicine modalities such as antibiotics and disinfectants, ozone therapy is quite economical; it will markedly reduce both medical cost and invalidity. Dentistry is varying with induction of modern science to practice dentistry. The ozone therapy has been more beneficial than present conventional therapeutic modalities that follow a minimally invasive and conservative application to dental treatment. The exposition of molecular mechanisms of ozone further benefits practical function in dentistry. Treating patients with ozone therapy lessens the treatment time with an immense deal of variation and it eradicates the bacterial count more specifically. The treatment is painless and increases the patients' tolerability and fulfillment with minimal adverse effects. Contraindications of this controversial method should not be forgotten. Further research is needed to regulate indications and treatment procedures of ozone therapy.

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