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Ozone Therapy-A Revolutionary Noninvasive Therapy in Dentistry

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Abstract

Ozone being a protective layer in the environment is also used for the treatment of diseases in medicine and dentistry. Ozone has a wide spectrum of action. Over 100 years it has been used in medicine. With standard protocols we can produce and utilize Ozone for the treatment of various dental diseases without any toxic effects. This article summarizes the noninvasive application of Ozone in the treatment of various dental diseases.

Keywords: Ozone therapy; Dental caries; Ozonated water; Oral microorganisms

Introduction

Ozone is a triatomic molecule with symbol O_3 it is continuously formed in the upper atmosphere as long as the sunlight is present. As it is heavier than air it comes down and removes pollutants and cleans air. The fresh smell after a rainfall is because of the Ozone. The Ozone has extensive use in the medicine and dentistry. In 1785 researchers noticed an odor, when electric sparks passed in an electrostatic machine. Finally in 1840 some chemists named the substance as Ozone, from the Greek word ozien –to smell. The first Ozone generator was developed by Werner Von Siemens in Germany in 1857 and in 1870 there is first report of Ozone being used therapeutically to purify blood by C Lender in Germany [1,2].

There is evidence of use of Ozone as a disinfectant from 1881, mentioned by in a book on Diphtheria. In 1893, the world's first water treatment plant using Ozone was installed in Ousbaden, Holland. During World War 1, Ozone was used medically to treat wounds and other infections. Before 1932 many Swiss dentists used Ozone in dentistry [1,2]. In 1957, a researcher patented on Ozone generator, which has lead to the extensive use of Ozone in medical practice [1]. Medical grade Ozone is a mixture of pure O_2 and pure O_3 in the ratio of 0.1% to 5% of O_3 and 95%-99.5% of O_2 [3,4].

There are 3 different systems of generating Ozone gas[-2]

1. Ultra violet system produces in low concentrations of Ozone used in esthetics, saunas, air purification.

2. Cold plasma system used in air and water purification.

3. Corona discharge system produces high concentration of Ozone.

The route of Ozone administration is topical or loco regional in gaseous or aqueous form or as Ozonated olive or sunflower oil. Irrigation is utilized for stomatitis, herpetic lesions and periodontal infections. Insufflation is used for decay, periodontal infections and endodontic treatment [5,6].

Mechanisms of Action

There are several potential actions of Ozone, which are applied in the clinical practice of dentistry and medicine, such as antimicrobial (bactericidal, viricidal and fungicidal), anti inflammatory, immunostimulating, antihypoxic and detoxicating, biosynthetic, (activation of the metabolism of carbohydrates, proteins, lipids) bio energetics, hemostatic etc. [5-7].

Clinical Applications of Ozone in Dentistry

With all the evidence of different actions and lack of toxicity Ozone is developed into a new non- invasive tool for the treatment of diseases in medicine and dentistry.

Treatment of dental caries

The application of Ozone therapy in the treatment of dental caries is extensively studied and many studies have proved its effectiveness in the treatment of pit and fissure caries, root caries and interproximal caries. Ozone is delivered through a hand piece, which is equipped with a silicon cup. The cup is applied directly to the tooth so that it forms a tight seal at the application site. The mechanism of action is due to its microbiological properties and its ability to oxidize the bacterial cell wall [7,8]. Pyruvic acid, that is produced by bacteria and implicated in the progression of caries, is oxidized by Ozone to acetate and carbondioxide.

This treatment is an alternative therapy to conventional drilling and filling for non cavitated deciduous carious lesion. The infusion of Ozone into non-carious dentin prevented biofilm formation in vitro from S.mutans and Lactobacillus acidophilus over a 4 week period [9]. Some studies have demonstrated that 40 s application of Ozone is sufficient to kill different concentrations of S.mutans and application of 60 s has almost completely eliminated S.mutans, L.casei and A.naeslundii [10]. Ozone is also found to be effective against the microflora associated with primary root caries lesions [11].

In a study the aqueous form of Ozone was found to be less cytotoxic than gaseous Ozone [12]. But it is reported to have a minimal effect on the viability of different bacterial species organized in a cariogenic biofilm [13]. According to some studies the application of Ozone gas to non-cavitated carious lesions does not significantly reduce the number of viable bacteria in the underlying infected dentin [14]. But it provided strong evidence that the mechanism by which Ozone application might be effective is not mediated by direct killing of bacteria in infected dentin [14]. Ozone treatment either alone or combined with a re-mineralizing

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solution was found to be effective for remineralization of initial fissure caries lesions [15,16]. But randomized double blind standardized clinical studies are still required to establish Ozone therapy in the treatment of dental caries. But it can be used in conjunction to the conventional treatment modalities.

Endodontics

In endodontic treatment instead of using irrigation chemicals (Naocl), Ozonated water can be used for irrigation. A Japanese study published in 2004 demonstrated the antimicrobial activity of Ozone in root canal treatment without any tissue toxicity. The study also shown that there was high metabolic activity of the associated fibroblasts indicated an increase in the healing process [17-19]. Procedure includes, the canals are prepared with files lubricated with ozonated oils and irrigated with ozonated water and dried. Before filling, a slow insufflation 45-60 sec into each canal should be done with concentration of Ozone using bout 30 ml.

In a study the aqueous form of Ozone was found to be less cytotoxic than gaseous Ozone [16]. Ozonated oils like Ozonated sunflower oil, olive oil and ground nut oil was efficient in canal sterilization than the conventional irrigation by the Sodium hypochlorite and Sodium peroxide combination. In a study on permeability of oral microorganisms and dental plaque, both gram +ve and gram –ve bacteria were killed by Ozonated water (0.5-4 mg/l).Gram –ve bacteria such as Porphyromonas endodontalis and Porphyromonas gingivalis were more sensitive to Ozonated water than gram +ve oral Streptococci and Candida albicans in pure culture and Ozonated water was proved to have bactericidal activity against bacteria in plaque biofilm.19But it was found that even after 20 minute of contact time of Ozonated water, gaseous Ozone and antiseptic agents did not have antibacterial effect on Enterococcus Faecalis [17]. Single visit treatment of infected root canals with and without ozonotherapy has resulted in complete remission of periapical lesions [18].

Periodontics

The effect of Ozone water on oral microorganisms and dental plaque were studied. Dental plaque samples are treated with 4 ml of Ozone water for 10 sec and was observed that gram +ve and gram –ve oral microorganisms and Candida albicans in pure culture as well as bacteria in plaque biofilm are killed, hence it was used to control oral microorganisms in dental plaque [19]. Ozone was found to considerably inactivate microorganisms causing periodontitis and antifungal effect was observed when compared to chlorhexidine, but did not show any antiviral effect [20,21].

The study of effect of ozonated water on proliferation of cells in periodontal ligament has resulted in the decontamination of root surface, without negative effect on the remaining periodontal cells on root surface [20]. And also there is reduction in the plaque index, gingival index and bleeding index by using ozone irrigation when compared to chlorhexidine [21].

Periodontal disease is a multifactorial disease. The sulci and pockets are irrigated with ozonated water to reduce the initial microbial load and insufflated with Ozone gas .The patients are also given ozonated oil to apply topically to the soft tissue. Silicon tray isolation technique can also be used where Ozone is introduced into the tray which fits the arch through the port of the tray. Excess gas is evacuated by a small evacuator which is attached to the outlet valve.

Prosthodontics

Disinfection of dentures is necessary to prevent denture stomatitis. The exposure of dentures to Ozonated water and ultrasonication had antimicrobial activity against C. albicans [22-24], there was no significant difference in antimicrobial activity against C. albicans by using both ozonated water with ultrasonication and commercially available denture cleaners. Gaseous O_3 was proved to be clinically useful for disinfection of dentures [22]. Reflectance, surface roughness and weight were measured after O_3 exposure of 20 mg/h caused a slight change in the Au-Cu-Ag-Pd alloy in terms of measured reflectance, but the changes were significantly less than those caused by acid-electrolyzed water & one of the commercial denture cleaners [23]. Methicillin-resistant Staphylococcus aureus (MRSA) and E coli T1 phage virus bacteria was 3.1 × 10(3) CFU/mL at the beginning of the experiment, fell to 1.0 × 10(0) CFU/mL 10 min later [25].

Oral surgery

Ozone was found to accelerate the healing of the wounds [26]. After a tooth is extracted or any surgical procedure the area is irrigated and insufflated which promotes faster healing without complications. Ozone therapy is found to be beneficial for the treatment of the refractory osteomyelitis in the head and neck in addition to treatment with antibiotic, surgery and hyperbaric oxygen. It also increases the benefits of surgical and pharmacological treatments causing complete healing of the lesions. A noninvasive surgery with pre and postsurgical cycles of Ozone therapy consisting of eight sessions lasting 3 minutes each besides antibiotics and antifungal therapies has been applied for the treatment of bisphosphonate induced osteonecrosis of jaw [27].

Oral medicine

Soft tissue lesions like Herpes, Aphthae, Removable denture ulcers, Cuts, Cheilitis, Candidiasis, Cysts and Traumatic wounds can be treated with either Ozonated water or oils. The disinfectant and healing properties help in the healing of these lesions.

Implants

In a study gaseous Ozone showed selective efficacy to reduce adherent bacteria on Titanium and Zirconia without affecting adhesion and proliferation of osteoblastic cells. Porphyromonas gingivalis was eliminated by Ozone from all surfaces with in 24 sec to below the detection limit (99.94%), while Streptococcus sanguis was more resistant and showed the highest reduction on zirconia substrates (90%) [28].

Contraindications for ozone therapy

Pregnancy, Glucose 6 phosphate dehydrogenase deficiency, hyperthyroidism, severe anemia, severe myasthenia, Ozone allergy, recent myocardial infarction, hemorrhage from any organ, acute alcohol intoxication [29].

Ozone toxicity

Therapeutic administration of Ozone did not cause any deleterious effects. European cooperation of medical Ozone societies prohibited the intravenous injections of Ozone gas due to risk of air embolism. But the inconsistent use of Ozone was reported to cause certain side effects like rhinitis, occasional nausea, vomiting, blood vessel swelling, poor circulation, heart problems respiratory tract irritation, at times stroke. In case of Ozone intoxication the patient must be placed in the supine

position, inhale humid oxygen and take ascorbic acid, vitamin E and N acetyl cysteine [4].

Conclusion

In the era of advancement in the methodologies of treatment Ozone therapy has evolved with success. This is one of the most minimally invasive treatment methods. The treatment time is reduced and according to some studies bacterial count is reduced precisely. It is absolutely painless procedure which increases patient acceptability and compliance with minimal adverse effects. Scientific support demonstrated by various studies shows Ozone therapy as a potential therapy in field of medicine and dentistry. According to Cochrane database there is lack of consistency between different outcome measures and absence of reliable evidence that application of Ozone gas reverses the decay [30]. Nevertheless *in vivo* randomized and well controlled clinical trials are the requirement of the day to establish it as a standard therapy.

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