Review Paper

Ozone Therapy - A Boon to Dental Sciences

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Abstract

Ozone therapy has successfully being used in the medical field for the treatment of various diseases for more than a decade. The versatility of ozone therapy, its unique properties like biocompatibility, antimicrobial, anti-inflammatory, immunostimulant, non-invasive nature, atraumatic, relative absence of side effects or adverse reactions, and better patient compliance were responsible for its widespread dental and medical use. Ozone (O_3) is used in dentistry as gas, ozonated water and as ozonated oils. This review of literature is an attempt to summarize its therapeutic potential in dentistry.

Key words: *ozone; ozone therapy; dental application; oxidative agent***.**

Introduction

Ozone (O_3) is a natural colourless gas made up of three oxygen atoms, a highly water soluble inorganic molecule with a pungent odor at room temperature. The word ozone originated from the Greek word ozein, which mean odor and was first discovered by German chemist Christian Friedrich Schonbein in 1840. He is considered as the "father of ozone therapy". Edward. A. Fisch first introduced ozone therapy in dentistry in the year 1930's, to aid in disinfection and wound healing during dental surgeries. Ozone therapy can be defined as a versatile bio-oxidative therapy in which oxygen/ozone is administered via gas or dissolved in water or oil base to obtain therapeutic benefits.[1,2] It is an excellent antimicrobial agent that induces oxidative stress, killing almost 99% of bacteria, fungi and virus when exposed for 10sec. Ozone has also proven itself as a powerful oxidizer agent for sterilization of medical instruments.[3,4,5] Currently, the role of ozone in dentistry mostly relays on its antimicrobial properties and treatment of jaw diseases.[6,7]

Despite the various benefits, ozone toxicity and clinical utility depend on its concentration, time and the site of administration. One of the major contraindications of ozone therapy is its lung inhalation causing increased airways resistance without changing the pulmonary compliance or elastic characteristics.[3,5] Intravenous injections of ozone/oxygen gas should not be practiced due to the possible risk of air embolism.[8] This article is based on information retrieved through valid textbooks, peer reviews, journals and medline/pubmed search.

Ozone Generation

Medical grade ozone generator for therapeutic use was first developed by German physicians named Joachim Hansler and Hans Wolff. Currently Corona Discharge method is used to generate controlled production of high ozone concentration where medical grade oxygen is made to flow through a high voltage tubes that contains a mixture of pure oxygen and pure ozone in the ratio of 0.05% to 5% of O_3 and 95% to 99.95% of O_2. In dentistry, two mostly used ozone units are the heal ozone [9] and ozotop.[10]

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Modes Of Ozone Administration

Ozone (O_3) is used in dentistry in three basic forms: gaseous, ozonated water and as ozonated oils. The route of Ozone administration is topical or locoregional. The ozone in gaseous form is applied through a silicon cup which gets adapted over the tooth, and is exposed for a minimum of 10 secs. The ozone in the silicone cup is collected again and reconverted to oxygen through a reducing agent by the apparatus.[11] Ozonated oils plant extracts - sunflower oil, olive oil and ground nut, are used externally in the form of thick gel containing ozonides. Irrigation is utilized for stomatitis, herpetic lesions and periodontal infections. Insufflation is used for decay, periodontal infections and endodontic treatment.[12-13]

Mechanisms of Action

The following properties of ozone therapy are employed:[7,11]

1) As disinfectant with sterilizing effect on bacteria, virus, fungi and protozoa due to oxidative damages. There is evidence that ozone directly inactivates bacterial toxins.

2) As a weak cytokine inducer that stimutates anti-inflammatory and immune responses.

3) Its hemostatic effect due to generation of H2O2 that causes irreversible platelet aggregation by activating phospholipase C, phospholipase A2, cyclo oxygenases and lipooxygenases, and thromboxane synthetase allowing increase in intracellular Ca2+ and release of prostaglandins E2 and F2a and Thromoxane A2.

4) Accelerates wound healing, improves oxygen supply due to stimulation of production of free radical scavengers like glutathione peroxidase, catalase, dismutase etc.

5) Biosynthesis and bioenergetics (activation of the metabolism of carbohydrates, proteins, lipids)

Clinical Applications of Ozone in Dentistry

With all the evidence of different actions and lack of toxicity, ozone has developed into a new non- invasive tool for treating myraids of problems related to dentistry.

Ozone Uses in Oral Medicine

Soft tissue lesions like herpes labialis[14], aphthae, removable denture ulcers, cuts, cheilitis, candidiasis, cysts and traumatic wounds can be treated with either ozonated water or oils. Ozonated oil applied on herpes labialis and mandibular osteomyelitis demonstrated faster healing times than conventional protocols.[8] Another study demonstrated that odontoblastic cells exhibited inflammatory responses against bacterial lipopolysaccharides (LPS). Ozonated water improved LPS-induced inflammatory responses.[15] Some studies have demonstrated that exposure for 60 sec kills 99.9% cariogenic bacteria such as Actinomyces naeslundii, Streptococcus mutans and Lactobacillus casei[16], in addition to degradation of salivary proteins. Thus 10-30 sec is recommended for killing a significant number of cariogenic bacteria.

Ozone Uses in Oral Surgery

Ozone therapy was found to accelerate wound healing[17] by facilitating oxygen release and blood suppy due to vasodilatation, following tooth extraction or implant dentistry.[18] Ozone therapy is found to be beneficial for the treatment of the refractory osteomyelitis and in cases of bisphosnate related osteonecrosis of jaw[19] as adjunct to treatment with antibiotic, surgery and hyperbaric oxygen.

Ozone Uses in Implantology

The use of ozone in implantology helps in bone regeneration. The socket is prepared conventionally and the ozone is bubbled into the prepared socket for about 40 sec. This is followed by placement of implant into the socket. This prevents infection and enhances bone regeneration. Studies have reported similar promising effects in cases of peri-implantitis.[20]

Ozone Uses in Periodontics

In a study by Nagayoshi et al.[21] dental plaque samples were treated with 4 mL of Ozone water for 10 sec and was observed that gram +ve and gram –ve oral microorganisms and Candida albicans was significantly reduced thereby reflecting its potential action in controlling micro-organisms in dental plaques. Also there is reduction in the plaque index, gingival index and bleeding index by using ozone irrigation as compared to

chlorhexidine.[22,23] Irrigation of the root surface of avulsed teeth for 2 min showed effective mechanical cleansing and decontamination of root surface without a negative effect on periodontal ligament cell proliferation.[24]

Ozone Uses in Prosthodontics

Gaseous O_3 was proved to be clinically useful for disinfection of dentures and other removable denture alloys without compromising their physical properties like reflectance, surface roughness and weight.[23,25] The exposure of dentures to ozonated water together with ultrasonication has antimicrobial activity against C. albicans.[23,26] Bacterial reduction was recorded in the ozone treated groups when compared with conventional and surgical methods to cure periimplantitis.[27]

Ozone Uses in Endodontics

The potential use of ozone gas, ozonated water and ozonized oil in endodontic therapy has been repeatedly reported in the literatures.[28,29] Intra canal gaseous ozone at a flow rate of 0.5–1 l/min with net volume of 5 gm/ml for 2–3min showed encouraging results against pathogenic microbes in the root canal. Ozonated water can be used as an intracanal irrigating solution and in cases with infected necrotic pulpal tissues enhancing tissue regeneration and healing process. Ozonated oils is found to be more efficient in canal sterilization than conventional irrigation by sodium hypochlorite (NaOCl), and sodium peroxide combination. Also when a root canal was disinfected by ozone water with sonification, the antimicrobial efficacy was comparable to 2.5% NaOCl.[30] The aqueous form of Ozone was found to be less cytotoxic than gaseous Ozone.[31] Ozone therapy also increases the scope of nonsurgical management of periapical lesions.

Ozone Uses in Orthodontics

Conventional orthodontic treatment requires the use of brackets bonded to the enamel surface of teeth for optimal tooth movement. Diffuse opacity white spot lesion develop at enamel bracket interface, due to microleakage or poor oral hygiene, causing demineralization of enamel. So, proper enamel prophylaxis is required in orthodontics, prior to bracket placement. Ghobashy et al.[32] evalauted the effects of ozonized olive oil gel in reducing enamel demineralization around orthodontic brackets. The use of ozonized olive oil gel along with standard prophylaxis showed significantly less decalcification of teeth among orthodontics patients. Pretreatment of enamel with prophylactic ozone enhances shear bond strength of orthodontic brackets bonded with total or self- etch adhesive systems.[33]

Ozone Uses in Pedodontics

The application of Ozone therapy helps to attain a positive rapport when dealing with a child patient to a great extent. The treatment with ozone is very fast, atraumatic, effective, painless and ensures better compliance and acceptability, making it an ideal choice for pediatric patients. Dahnhardt et al.[34] found 93% of total reduction of anxiety in treating carious teeth with ozone in anxious children. Ozonated water is also recommended before replantation of avulsed teeth.

Management 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. It acts by oxidizing the pyruvic acid produced by cariogenic bacteria to acetate and carbon dioxide.[35] The treatment provides an alternative therapy to conventional drilling and filling for non cavitated deciduous carious lesion. Ozone treatment either alone or combined with a re-mineralizing solution was found to be effective for remineralization of initial fissure caries lesions.[36,37] Randomized double blind standardized clinical studies are however required to establish Ozone therapy as the stand-alone treatment of dental caries. Application of ozone for 40-60 sec also reduces dentinal hypersensitivity of teeth, instantly.[30]

Ozone and Dental Unit Water Lines (Duwl)

Kohno *et al*., published their results that sbowed acidic electrolyzed water could be applied as an appropriate measure against bacterial contamination of the DUWL.[38] In model dental unit water lines, ozone achieved a 57% reduction in biofilm and a 65% reduction in viable bacteria in spite of being used in a very low dose and with a short duration of application.[39]

Conclusion

The use of ozone has opened new vistas in treatment modalities. Now, with ozone treatment the fear of injections and drills has become the thing of past. Treating patients with ozone reduces the treatment time with a great deal of difference, eliminates the bacterial count more effectively, and moreover, it is completely painless, so increase the patients' acceptability and compliance. Ozone, definitely, seems to be a promising treatment modality for various dental problems in future. On the other hand we have to keep in mind that presently ozone is an adjunct to other conventional treatment modalities and should be used in combination until more research shows its benefits in independent usage.

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