Review Article

The Ozone: Protecting the Oral Environ…………..

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Abstract

Oxygen/ozone therapy is a term that describes a number of different practices in which oxygen, ozone, or hydrogen peroxide are administered via gas or water to kill disease microorganisms, improve cellular function, and promote the healing of damaged tissues. Ozone gas is immunostimulating, potent analgesic, detoxicating, antimicrobial, bioenergetics and biosynthetic properties as it causes activation of the metabolism of carbohydrates, proteins and lipids. The use of ozone has been advocated in Medical and Dental science due to its excellent antimicrobial, disinfectant and effervescent properties. The purpose of this article is to review the therapeutic applications of ozonated products in dentistry.

Introduction

The word ozone is derived from the Greek word ozein (odorant).1 Ozone (O3) is a triatomic molecule, consisting of three oxygen atoms. Its molecular weight is 47,98 g/mol. Ozone is thermodynamically highly instable compound that, dependent on system conditions like temperature and pressure, decomposes to pure oxygen with a short half-life.2 The German chemist, Schonbein, first discovered ozone in 1840. The first medical application was in 1870 when Lender purified blood in test tubes with ozone.3 In the 1920's Edwin , a Swiss dentist started to use O3 as part of his disinfection system.1 As of 1929, more than 114 diseases were listed for treatment with oxygen/ozone therapy.[3]

Ozone is one of the most powerful antimicrobial agents available for use in medicine and dentistry.1Early in its history ozone was found to oxidize a spectrum of organic compounds and to interact with unsaturated chemical bonds.[4] Since ozone is a powerful oxidizer, it effectively kills bacteria, fungi, viruses, and parasites at a dramatically lower concentration than chlorine, with none of the toxic side effects. One molecule of ozone is equal to about 3,000 to 10,000 molecules of chlorine and it kills pathogenic organisms 3,500 times faster. Introduction of oxygen/ozone therapy has truly revolutionized dentistry. This newer concept addresses the multifactor infective states within the oral cavity in an effective, safe, nontoxic manner.[3]

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In dental practice ozone therapy was first evaluated in 1933 for the treatment of oral lesions and chronic periodontal infections. Intraorally, ozone can be used to treat chronic periodontitis, caries, infections after dental extractions, lesions caused by radiotherapy, aphthae and mycoses, and can be used for disinfecting root canals.[5] Oxygen/ozone therapy in dentistry contains a multiplicity of protocols to deal with dental infection. Three basic forms of application to oral tissue are applied - 1) ozonated water, 2) ozonated olive oil, and 3) oxygen/ozone gas. Ozonated water and olive oil have the capacity to entrap and then release oxygen/ozone, an ideal delivery system. These forms of application are used singly or in combination to treat dental disease.[6]

Medical Ozone is made when medical grade oxygen is electrically activated (using an Ozone Generator) to form ozone. It is a mixture of the purest oxygen and purest ozone.[7] In a medical/dental ozone generator, the medical grade O^2 is converted to O^3, in special tubes via a corona dischrge reation (similar to lightning).This type of generator is able to control the concentration of ozone, critical to delivering the correct doses in micorgarams/milliliters (mcg/ml). Concentration is determined by exposure and contact time of the medical-grade oxygen to the 5 to 13 millivolts [Bocci] sealed-corona discharge tubes. Because of ozone's physical properites in the dental model, the ratio of ozone to oxygen is extremely low. The typical average conentration of ozone used in treatments is 25 micrograms of ozone per milliliter of oxygen/ozone gas mixture. That translates into 0.25 parts of ozone to

99.75 parts of oxygen.[3] There are three systems for generating ozone gas. Ultraviolet system produces low concentrations of ozone, used in aesthetics and for air purification. Cold plasma system is 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.[3,7]

Mechanism of action

The mechanism of action for ozone therapy remains hypothetical but possible explanations of its effect is characterized by the formation of reactive oxygen species (ROS) during the ozonation process which function as physiological enhancers of various biological processes.8 It acts on cells by damaging its cytoplasmic membrane due to ozonolysis of dual bonds and also ozone-induced modification of intracellular contents (oxidation of proteins loss of organelle function) because of secondary oxidant effects. This action is non-specific and selective to microbial cells; it does not damage human body cells because of their major antioxidative ability.[7] In viral infections the mechanism of ozone action lies in the intolerance of infected cells to peroxides and change of activity of reverse transcriptase, which takes part in synthesis of viral proteins.[2] 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 micro-organisms to phagocytosis.[2] When administered at low concentrations, the organisms own resistance is mobilized, i.e. ozone (re)activates the immune system. As a response to this activation through ozone, the body's immune cells produce special messengers called cytokines. These molecules in turn activate other immune cells, setting off a cascade of positive change throughout the immune system, which is stimulated to resist diseases.[7] Ozone causes the synthesis of biologically active substances such as interleukins, leukotrienes and prostaglandins which is beneficial in reducing inflammation and wound healing.[7] Ozone brings about the rise of Po_2 in tissues and improves transportation of oxygen in blood, which results in change of cellular metabolism - activation of aerobic processes (glycolysis, Krebs cycle, ?-oxidation of fatty acids) and use of energetic resources. It also prevents formation of erythrocytes, aggregates and increases their contact surface for oxygen transportation. Its ability to stimulate the circulation is used in the treatment of circulatory disorders.[7] It also activates mechanisms of protein synthesis, increase amount of ribosomes and mitochondria in cells. These changes on the cellular level explain elevation of functional activity and regeneration potential of tissues and organs.[2]

Mode of ozone administration

Direct intra-arterial and/or intravenous injection was first used by Lacoste in 1951 for circulatory compromise and possible sequelae such as gangrene. An oxygen-ozone mixture is slowly injected into an artery or vein with a hypodermic syringe. This method is used primarily for arterial circulatory disorder.[4,8] Rectal insufflations have been used in various health problems such as ulcerative colitis, cancer, HIV-related problems and others. A mixture of ozone and oxygen is introduced through the rectum and absorbed into the body through the intestine. Intramuscular injection is commonly used to treat allergies and inflammatory diseases. Major and minor autohemotherapy involve removing an amount (usually 10 mls for minor and 50 mls for major) of the patient's blood from a vein with a hypodermic syringe. The blood is then mixed with oxygen-ozone and return to the patient intravenously. These methods have been used to treat arthritis, cancer, heart disease and HIV infection. 8 Ozonated water finds applications in dental surgery where it is reported to promote hemostasis, enhance local oxygen supply and inhibit bacterial proliferation. Applied following tooth extraction or during dental surgery it may also be rinsed in conditions such as thrush and periodontal disease, and swallowed to soothe gastritis. The ozone gas is bubbled through water and the water is used externally.[4,8] Intra-articular injection is used primarily to treat arthritis, rheumatism and other joint diseases. In this method, ozone gas is bubbled through water and the mixture is injected directly between the joints. Ozone bagging is a non-invasive method that uses a specially made plastic bag that is placed around the area to be treated. An oxygen-ozone mixture is pumped into the bag and mixture is absorbed into the body through skin. Ozone bagging is primarily recommended for treating leg ulcers, gangrene, fungal infections, burns and slow healing wounds.[8] Ozonated oils are pure plant extracts through which pure oxygen and ozone are passed. Used primarily to treat skin problems, ozone gas is added to olive oil and applied as a balm or salve for long-term, low-dose exposure.[1,8]

Why the ozone therapy ??

Eliminates the use of drills and fillings, eliminates the use of anaesthetics, kills 99% of bacteria in cavities, can whiten discoloured cavities, excellent for nervous

or anxious patients, reduces inflammation and pain sensation.[7]

Indications

Prophylaxis and prevention of dental caries, remineralisation of pit and fissure, root and smooth surface caries, restoration of open cavitations along with conventional conservative measures, bleaching of discoloured root canal treated teeth, endodontic treatment, desensitization of extremely sensitive tooth necks, soft tissue pathoses, treatment of infected, badly healing wounds and inflammatory process, implantology.

Contraindications and toxicity

Pregnancy, severe anaemia, hyperthyroidism, thrombocytopenia, severe myasthenia, acute alcohol intoxication, recent myocardial infarction, hemorrhage from any organ, Glucose-6-phosphatedehydrogenase deficiency and ozone allergy.[3,9] Ozone transformation may be poisionous to pulmonary complement as good as pick organs. Complications caused by ozone caring have been sparse during 0.0007 per application. Known side effects are epiphora, upper respiratory tract irritation, rhinitis, cough, headache occasional nausea, vomiting, crispiness of breath, blood vessel swelling, bad circulation.[3,1]

A novel therapeutic approach in dentistry:

Oral medicine

The ozone has been reported to accelerate the healing of soft tissue conditions like aphthous ulcers, herpes labialis, ANUG and other gum infections.3 All viruses are susceptible to ozone's neutralizing action. Relative susceptibility in ascending order was found to be: poliovirus type 2, echovirus type 1, poliovirus type 1, coxsackie virus type B5, echovirus type 5, and coxsackie virus type A9. In pure water, at maximal solubility of ozone and room temperature, echovirus type 29 is inactivated in one minute, poliovirus type 1 in two, type 3 in three, and type 2 in seven minutes. Analysis of viral components showed damage to polypeptide chains and envelope proteins, which could result in attachment capability compromise, and breakage of the single-stranded RNA producing replicating dysfunction. Lipid-enveloped viruses are sensitive to treatment with ether, organic solvents, and ozone, indicating that disruption or loss of lipids results in impaired or destroyed infectivity. Viruses containing lipid envelopes include the Hepadnaviridae (Hepatitis B), the Flaviviridae (hepatitis C, West Nile virus, yellow fever); the Herpesviridae, a large family grouping the Simplex, Varicella-Zoster, Cytomegalovirus, and Epstein-Barr viruses; the Orthomyxoviridae (avian influenza); the Paramyxoviridae (mumps, measles); the Coronaviridae (SARS); the Rhabdoviridae (rabies); the Togaviridae (Rubella, encephalitis); the Bunyaviridae (Hantavirus); the Poxviridae (smallpox); and the Retroviridae (HIV), among others. Indeed, once the virion's lipid envelope becomes fragmented, its DNA or RNA core cannot survive. [2]

Prosthodontics

Denture plaque control is essential for the prevention of denture stomatitis. Arita et al. assessed the effect of ozonated water and found no viable C. albicans following exposure to flowing ozonated water (2 or 4 mg/l) for one minute.7Direct exposure to gaseous ozone was a more effective microbicide compared with ozonated water.[9]

Oral surgery

In chronic mandibular osteomyelitis, it was observed that medical ozone exposure promoted more complete and rapid normalization of nonspecific resistance and T-cellular immunity, thus accelerating clinical cure and reducing the incidence of complications. Dental extraction becomes possible in a patient with avascular bisphosphonate-related jaw osteonecrosis or in those who received pyrophosphate analogous when treated with ozone therapy.[9] Ozone encourages wound healing as well as controls opportunistic infections, daily treatment with ozonated water accelerates the physiological healing.1Application of ozone therapy after tooth extraction and in case of post-extraction complications, was found quite useful.[7]

Periodontics

Periodontal disease is a multifactorial disease process in the mouth.[10] Due to the physics of a gas entering into a liquid, the crevicular fluids and the epithelial tissues lining the sulcus absorbs the oxygen/ozone mixture, ensuring complete anaerobic pathogen load elimination. In addition the tissue responds with increased perfusion and immunologic activity allowing for enhanced healing.[3] Ozonated water has strong bactericidal activity against bacteria in plaque biofilm. Ozonated water (0.5 to 4 mg/l) was found to be highly effective in killing both gram - positive and gram - negative microorganisms. Gram - negative bacteria such as Porphyromonas gingivalis, Porphyromonas endodontalis were more sensitive to ozonated water than gram positive oral streptococci and Candida albicans in pure culture.[1] Application of ozone,

desensitization of dentine lasts for longer period of time. 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.[9]

Operative dentistry

Oxygen/ozone can be utilized for pit and fissure sealants, caries removal, cavity preparation, crown & bridge preparation and reduce carious exposure.[3] The procedure is to isolate the tooth or preparation and flow the gas into the area, the area to be treated slowly for 45-60 seconds. The use of proper evacuation technique is essential to avoid inhalation of gas. This procedure will kill or significantly inhibit any possible microbial infection at the site with a reduction of postoperative hypersensitivity.[10] In cases of incipient caries, ozone can kill bacteria in the demineralized part and demineralized tooth structure then, can be mineralized using a special remineralized kit containing calcium, fluorine, phosphorus and sodium, all in their ionic form.[3] Since oxygen is the only gas that can carry an electrical charge, this opposite charge phenomena attracts ozone to the area and the pathogens are killed. Taking into consideration the routes of oxygen/ozone application, root canal therapy goes through a paradigm change. The additions to treatment are as follows: Files are coated with ozonated olive oil for lubrication and disinfection. The canals are prepared, irrigated with ozonated water, and dried.The final step before filling each canal is slow insufflation with oxygen/ozone gas. The insufflation process allows the molecular oxygen/ozone to travel into the canals, lateral canals, and tubules. The molecular oxygen/ozone can travel through the tubules and kill the positively charged microbes and perform a true sterilization. The results following the use of above steps have shown less post operative complications, fewer retreatments and no reinfection of dentition.[3,6]

Conclusion

In comparison with classical medicine modalities such as antibiotics and disinfectants, ozone therapy is quite inexpensive, atraumatic, biologically based treatment and is used in almost all aspects of dentistry. Ozone is the perfect substance for use in dental procedures. It disinfects the tissues treated and leaves no toxic residues like chlorinated products. It performs this task by oxidizing the cell membranes of pathogenic organisms and killing them. Used as a preventive agent in pit and fissure caries and as a therapeutic agent in primary root caries. Used as an irrigating agent in endodontic, and adjuvant in periodontal surgical and maintenance phase. Ozone therapy shows considerable promise and dentists should be aware of these developments and follow its progress. Though the evidence for this novel preventive treatment option is currently insufficient to make widespread recommendations, changes in dental practice should be explored to see how oral health can be best supported through novel preventive systems.

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