Versatility of Ozone Therapy in Dentistry: A Literature Review

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ABSTRACT
Ozone (O₃) acts as a protective layer in the environment from harmful UV rays. Over 100 years, ozone has been used in the medicine. Due to its unique property, noninvasive nature and wide spectrum of action, it has been used in dentistry also. Ozone has been used in treatment of alveolitis, osteoradionecrosis of jaw, bacterial and viral infections, implantology. It also inhibits plaque formation, thereby make a good prognosis of periodontal therapy. Ozone has also been used in dental unit water line to disinfect water. It is atraumatic. More trials are needed for precise indications and guidelines for successful dental treatment.

Keywords: Ozone, Ozone therapy, Microorganism, Disinfection.

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INTRODUCTION
Ozone derived from the Greek word ozien means to smell. Ozone (O₃) is normally present in upper atmosphere as a gas made of three atoms of oxygen with a cyclic structure. Ozone is 1.6-fold denser and 10-fold more soluble in water (49.0 ml in 100 ml water at 0°C) than oxygen. It is the third most potent oxidant after fluorine and persulfate. Ozone was a controversial gas toxic for pulmonary tract when mixed with nitrogen dioxide, carbon monoxide, thereby forming photochemical smog and thus makes it a controversial gas. Few ozone therapists rely only on dosage without sufficient knowledge of its mechanism of action and toxicity. In some underdeveloped countries, ozone is injected intravenously by inexperienced persons who were prohibited since 1984 due to possible risk of pulmonary embolism and, therefore, death of the patient. An American chemist once spoke that ozone is a toxic gas to deal with and should never be used in medicine. This situation abstain many therapist from the use of ozone therapy inspite of the fact that ozone can be used as one of the best disinfectants. Ozone has not been used before due to lack of precise generator, clinical and scientific data, toxicity due to lack of regulation from health authorities, financial support. For its use in medicine, ozone must be controlled with ozone generator equipped with a well-standardized photometer by collecting a precise gas volume with a defined ozone concentration. In 1785, when electric sparks passed in an electrostatic machine researchers noticed an odor. Finally, in 1840, some chemists named the substance as ozone. The first ozone generator was developed by Werner Von Siemens in 1857 and in 1870 ozone being first used therapeutically to purify blood by C Lender in Germany. In World war I, ozone was applied to treat post-traumatic gas gangrene for German soldiers. The application of ozone was first done by Joseph Hansler (1908-1981). Since last century, the use of ozone therapy has increased slowly. The three different systems of generating ozone gas were (1) ultraviolet system, used in sauna, esthetics and water purification, (2) high concentration of ozone generator by corona discharge system, (3) cold plasma system for water and air purification.

The route of administration is topical or loco regional in gaseous or aqueous form or as ozonated olive or sunflower oil. The gaseous form is used as open system or by sealing suction system to avoid inhalation and thus avoid adverse effect. Ozonated water has been found efficacious against viruses, bacteria and fungi. In addition to disinfectant and sterilizing effect, ozonated water has hemostatic effect. Irrigation and insufflations of ozone is used in periodontal, herpetic lesion, decay and endodontic cases for wound healing, to improve oxygen and metabolic process in applied area. Due to development of antibiotic resistance, eradication of bacteria is not possible, but evidence suggested that ozone gas inactivates bacterial toxins which was unaffected by antibiotics. A study done on cytotoxic effect of aqueous and gaseous ozone on gingival fibroblast and oral epithelial cells in respect to chlorhexidine di gluconate 0.2%, sodium hypochlorite 5.25%, 2.25% and hydrogen peroxide 3% showed aqueous ozone was compatible than other antiseptics. Irrigation of aqueous ozone on root surface of avulsed tooth showed proliferation of periodontal cells. The ozone therapy is...
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Mechanism of Action

In dentistry and medicine, ozone acts as antimicrobial, antihypoxic, anti-inflammatory, hemostatic, bioenergetics, and biosynthetic. Ozone reacts with polyunsaturated fatty acids, antioxidants (ascorbic and uric acid, thiols like albumin, cysteine, glutathione. Ozone is dose dependant and affects DNA, RNA, enzymes along with carbohydrates. Ozone causes cell lysis by disrupting microbial cell structure mostly in dental caries and associated biofilms. Application done for 10 to 20 seconds till 40 seconds. Low concentration of ozone (0.1 ppm) is sufficient to remove bacteria along with spores.

Ozone acts on lipid envelope of viruses. It damages polypeptide chains and envelope proteins, thus impair viral attachment, and also cause breakage of viral RNA. On blood cells, ozone reduces clumping of red blood cells, and thus enhances its flexibility and oxygen carrying capacity. Thus, there is a production of free radical scavengers like glutathione peroxidase, catalase, and superoxide dismutase. On leucocytes, ozone acts as a weak cytokine, such as interleukin 2, 6, 8, transforming growth factor-β (TGF-β) inducer, tumor necrosis factor-α (TNF-α), Ozone also reacts with the unsaturated fatty acids of the lipid layer in cellular membranes thus forming hydrogen peroxides, which is a most significant cytokine inducer. Hydrogen peroxide generated by blood ozonation activates, phospholipase A2, cyclo-oxygenases and lipoxygenases, thromboxane synthetase, which increases intracellular calcium along with release of prostaglandin F2, E2, thromboxane A2 with irreversible platelet aggregation.

Treatment Goals of Ozone in Dentistry

Attempts to eliminate oral infections are a challenge due to multiple causative factors. These includes microorganism, saliva, diet, immune response. The altered risk factors are surgical procedures, sealants, fluorides, prophylaxis, diet and lifestyle modification. The pathogenic opportunistic infection affects the afflicted tissue. Instead of treating with antibacterial, antiviral or antifungal agents, ozone may be a safe alternative to treat the infective agents. In a study, the author found a statistically significant difference in the size of inhibited bacterial growth zone on all media depending on the time of action. The bactericidal activity of ozone in relation to bacterial strains isolated from the oral cavity was confirmed that ozone control the bacterial activity. In short, ozone is used in (1) restoration of proper oxygen metabolism, (2) elimination of pathogens, (3) induction of a friendly ecologic environment, (4) immune activation, (5) simulation of the humoral anti-oxidant system, (6) increased circulation and (7) oxidize bacterial cell wall and cytoplasmic membrane.

CLINICAL APPLICATION OF OZONE IN DENTISTRY

Oral Surgery

After tooth extraction or any other surgical procedure, the area is irrigated and insufflated which accelerates wound healing without complications. Ozone therapy is found to be beneficial for osteomyelitis in the head and neck along with antibiotic, surgery and hyperbaric oxygen therapy. With ozone therapy, complete healing of lesion takes place, thereby increased the benefit of surgical and pharmacological treatments. For treatment of bisphosphonate induced osteoradionecrosis, eight sessions of pre- and post-surgical cycles of ozone therapy for 3 minutes along with antifungal and antibiotic therapy offered good results. There has been some success with intraosseous injections and intraoral silicone tray treatment of the osteonecrotic lesion.

Implantology

Ozone helps in bone regeneration. In conventionally prepared socket, ozone is bubbled for 40 seconds and implants are placed. In cases of peri-implantitis, ozone therapy showed elimination of infection.

Periodontics

Periodontal disease is a multifactorial disease. In patients undergoing scaling, root planning, laser therapy, ozonated water can be used during ultrasonic debridement.

In a study on oral microorganisms and dental plaque, samples were treated with 4 ml of ozone water for 10 seconds and was observed that bactericidal effect on gram +ve and gram –ve oral microorganisms and Candida albicans on plaque biofilm, and hence it was used to control oral microorganisms in dental plaque. Irrigation with ozonated water in sulcus and pockets showed reduction in initial microbial load. The patients are also given ozonated oil to for topical application. 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. Evacuation of excess gas was done with small evacuator. Ozonated oil can be used as a effective therapeutic alternative in acute necrotizing ulcerative gingivitis cases.
Endodontics

Ozonated water can be used for irrigation as an alternative to irrigation chemicals sodium hypochlorite (NaOCl). Ozonated oils like ozonated sunflower oil, olive oil, and ground nut oil was efficient in canal sterilization. A study demonstrated the antimicrobial activity of ozone in root canal treatment without any toxicity. In this study, use of ozone showed fast healing process due to increased fibroblastic activity. In root canal procedure, satisfactory result was seen when the canals prepared with files dipped in ozone oil and irrigation with ozonated water before drying. Slow insufflations of 30 ml ozonated water or gas for 45 to 60 seconds before filling each canal provides effective and sufficient result. Various studies have shown that ozone therapy inhibits pit and fissure caries, root caries, interproximal caries. Its antimicrobial action has been demonstrated against bacterial strains, such as Streptococcus, Escherichia, Staphylococcus aureus, Peptostreptococcus, Candida albicans, Pseudomonas aeruginosa, Enterococcus faecalis. In discolored nonvital tooth, after removing root canal filler material, the canal is sealed up to cemento enamel junction. After placing bleaching agent in inner tooth, the crown is irradiated with ozone for 3 to 4 minutes. Reversal of caries in lesion was seen in 10 seconds after administration.

Prosthodontics

To prevent denture stomatitis, ozone application as denture cleaner is effective in Candida albicans, methicillin resistant Staphylococcus aureus and viruses. After exposure to ozone, the reflectance surface roughness and denture weight were measured which showed slight change in alloy properties which was significantly less than those caused by commercial denture cleaners and acid electrolyzed water in terms of measured reflectance.

Oral Medicine

Soft tissue lesions like aphthae, denture ulcers, herpes, cuts, cheilitis, cysts, candidiasis and traumatic wounds can be treated with ozonated water or oils. This helps in the healing of these lesions.

Other Uses of Ozone

The oxygen ozone gas mixture was highly effective in lower back pain, both acute and chronic, sciatica and as replacement of epidural steroidal drugs. In another study, ozone nucleolysis provides excellent pain relief in most prolapsed lumbar intervertebral disc patients. A study done by Vijay kumar et al showed ozone can be used as valid alternative for surgical decompression in cases of disc prolapsed in cauda equine syndrome. Olezeon (ozonized sunflower oil), a medicine produced in Cuba showed good result in Tenia pedis.

Contamination of dental unit water system possesses a threat worldwide due to harboring of bacteria when not in use, thereby infecting the dental surgeons and associated staffs. It also affects the adhesion of resins to enamel. According to Montebugnoli et al, ozone can be used in water purification due to its lesser side effects. These studies concluded that dental unit manufacturers should incorporate automated devices to disinfect water lines in dental set up. In a model unit water line, low dose ozone showed reduction in biofilm in short time of application.

Contraindications for Ozone Therapy

Ozone allergy, pregnancy, hyperthyroidism, myasthenia gravis, recent myocardial infarction, anemia, hemorrhage, acute alcohol intoxication, glucose 6 phosphate dehydrogenase deficiency.

Ozone Toxicity

There is no deleterious effect on administration of ozone. Due to risk of air embolism, European cooperation of medical ozone societies prohibited the intravenous injection. Certain side effects like nausea, vomiting, rhinitis, blood vessel swelling, poor circulation, heart and respiratory tract problems. In case of ozone intoxication, the patient must be placed in the supine position, administration of humid oxygen should be done along with ascorbic acid, vitamin E and N acetyl cysteine.

CONCLUSION

In dentistry, ozone is used in almost all specialties. Ozone therapy is used nowadays as minimally invasive method of treatment. As the procedure is painless and has minimal side effect, patient’s acceptability is more. This therapy also lessens various treatment time and also decreases the chance of infection. More clinical research is needed to standardize indications and treatment procedures; hopefully, the use of ozone therapy becomes a standard treatment protocol in dentistry.

REFERENCES

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