ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at: www.ijmacr.com

Volume – 5, Issue – 2, March - April - 2022, Page No. : 206 – 211

Ozone - A revolutionary therapy in dentistry - A review

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How to citation this article: Dr. Adusumilli Venkata Surya Pavan Kumar, Dr. L. Meghana, Dr. M. Sriramya, Dr. S.R.D.S. Manikanta N, “Ozone - A revolutionary therapy in dentistry -A review”, IJMACR- March - April - 2022, Vol – 5, Issue - 2, P. No. 206 – 211.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

ozone has been used successfully for the treatment of various diseases for more than a decade. Its unique properties include immunostimulant, analgesic, anti-hypnotic, detoxicating, antimicrobial, bioenergetic and biosynthetic actions. Its atraumatic, painless, non-invasive nature, and relative absence of discomfort and side effects increase the patient’s acceptability and compliance thus making it an ideal treatment choice specially for pediatric patients. This review is an attempt to highlight various treatment modalities of ozone therapy and its possible clinical applications in future.

Keywords: ozone therapy, immunostimulant, viricidal, biocompatible, analgesic, bactericidal.

Introduction

Ozone also known as triatomic oxygen and trioxygen is a naturally occurring compound consisting of three oxygen atoms. Ozone, a naturally found gas in the upper atmosphere filters potentially damaging ultraviolet light from reaching the Earth’s surface. In 1840, Shonbein named the substance, which gave odour ozone, from the Greek word “ozein”-to smell. Ozone has a long history of research and clinical applications. Ozone therapy was accepted as an alternative medicine in the USA from 1880 and has been used for over 130 years in twenty countries throughout the world. During World War I, ozone gas was used for treating gaseous post-traumatic gangrene, infected wounds, mustard gas burns and

fistulas in German soldiers. E.A. Fisch was the first dentist to use ozone in his practice in the 1930s. He used ozonated water during dental surgeries to aid in disinfection and wound healing. Today ozone therapy is used extensively in both dentistry and medicine. Ozone therapy can be defined as a versatile bio-oxidative the rapyin which oxygen/ozone is administered via gas or dissolved in water or oil base to obtain therapeutic benefits.[1,2,3]

Mechanism of action

Ozone has

been shown to possess unique properties and has potential applications to the clinical practice of dentistry and medicine. There are several known actions of ozone, such as antimicrobial (bactericidal, viricidal, and fungicidal), immunostimulating, immune modulatory, anti-inflammatory, biosynthetic bioenergetic, anti-hypoxic, analgesic, hemostatic, etc.[4]

Effect on bacteria, virus, fungus, protozoa

- Bacteria: Ozone acts on bacterial cell membranes, by oxidation of their lipid and lipoprotein components. There is evidence for interaction with proteins as well. Ozone seems to render the spores defective in germination, perhaps because of damage to the spore's inner membrane.[5]
- Virus: All viruses are susceptible to ozone; yet differ widely in their susceptibility. Lipid-enveloped viruses are especially sensitive to ozone. Analysis of viral components showed damage to polypeptide chains and envelope proteins impairing viral attachment capability, and breakage of viral RNA.[6]
- Fungal and protozoa: Ozone inhibits cell growth at certain stages.[7]

Mode of application

- Ozone gas: Ozone generating equipment converts oxygen to ozone. The ozone is thereafter led to a hand piece fitted with a silicone cup. Differently shaped silicone cups are available that correspond to the form of various teeth and their surfaces. This ensures close contact between the silicone cup and the carious area of the tooth so that the ozone does not escape. The ozone is led through the silicone cup over the tooth for a minimum of 10 s. The ozone in the silicone cup is collected again and reconverted to oxygen by the apparatus.
- Ozone aqueous solution: The following properties of ozone are used in this case: Disinfectant and sterilizing effect; Hemostatic effect, especially in cases of hemorrhages; Accelerated wound healing, improved oxygen supply and support of metabolic processes
- Ozone oil: Ozonated oils are pure plant extracts, through which pure oxygen and ozone are passed. The plant extracts undergo a chemical reaction to form a thick, viscous oil, or in some cases, a petroleum jelly-like product. The final products contain ozonide's. This method of external application is harmless.[8]

Ozone in oral medicine

Herpes lesions have been studied with topical ozone administration. Ozonated oil applied on herpes labialis and mandibular osteomyelitis demonstrated faster healing times than conventional protocols.[8] Ozone, in these cases, neutralizes herpes virions by direct action, thus inhibiting bactericidal superinfections, and stimulating the healing of tissues through circulatory prompting.

Ozone has been proven to be one of the most powerful oxidants we can use in dentistry.[9]

Ozone in oral surgery

Ozone is known to encourage wound healing as well as control opportunistic infection. It was shown that daily treatment with ozonized water accelerates the physiological healing rate. In a study which compared the use of ozonated oil in an experimental group to a control group in which antibiotic therapy was used in the treatment of alveolitis, it was found that patients treated with ozonated oil healed more quickly. Ozone was used in the treatment of avascular osteonecrosis of the jaw (ONJ). There was complete healing of the lesions with the disappearance of symptoms.[10-13]

Ozone in periodontics

Ozonated water inhibited the accumulation of experimental dental plaque in vitro. Ozonated water had strong bactericidal activity against bacteria in plaque biofilm. It was found that ozonated water (0.5–4 mg/L) was highly effective in killing of both gram- positive and gram-negative microorganisms. Gram-negative bacteria, such as Porphyromonas gingival is, Porphyromonas Endodontalis were more sensitive to ozonated water than gram-positive oral streptococci and Candida albicans in pure culture.[14] One study concluded that the addition of ozone to a ultrasonic cleaning system containing different experimental solutions resulted in antibacterial activity against Staphylococcus aureus. Ozonated water has an excellent anti- inflammatory capacity.

Re searchers choose the NF- kappa B system, a paradigm for inflammation- associated signaling/ transcription. Their results showed that that NF-kappa B activity in oral cells in periodontal ligament tissue from root surfaces of periodontally damaged teeth was inhibited following incubation with ozonized medium. The use of ozone around implants is supported by published research showing that ozone not only effectively sterilizes the surfaces of both the implant and bone, but also initiates the reparative mechanisms allowing tissue regeneration around implant surface.[15]

Ozone therapy in restorative dentistry

Ozone, in gaseous or aqueous phase, has been shown to be a powerful and reliable antimicrobial agent against bacteria, fungi, protozoa, and viruses Ozone has a severely disruptive effect on cariogenic bacteria, resulting in elimination of acidogenic bacteria. The strongest naturally occurring acid, produced by acidogenic bacteria during cariogenesis is pyruvic acid. Ozone can decarboxylate this acid to acetic acid. It has been shown that remineralization of carious lesions can be encouraged when the production of acetic acid, or other high pKa acids found in resting plaque, buffers plaque fluid.[16] Treatment with ozone gas significantly reduced caries progression, remineralised and arrested carious lesions in patients at high caries risk. It was also observed that ozone treatment being noninvasive provoked least state of anxiety compared to traditional dentistry. Nonactivated lesions were more likely to reverse than cavitated lesions. Initial studies have indicated that an application of ozone is capable of clinically reversing leathery root carious lesions.[17]

Use in endodontics

The oxidative power of ozone characterizes it as an efficient antimicrobial. Its antimicrobial action has been demonstrated against bacterial strains, such as Mico bacteria, Strep to coccus, Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Pepto streptococcus, Enterococcus faecalis, and Candida albicans. Notably, when the specimen was irrigated with sonication, ozonated water had nearly the same antimicrobial activity as 2.5% NaOCl. A study evaluated

the effects of intracanal medication using ozonated oil compared to a calcium hydroxide paste associated with camphorated paramo no chlorophenol and glycerin (HPG) for the endodontic treatment of teeth with periapical lesions. The radiographic, histopathological, and his to bacteriological analysis showed no significant differences between periradicular tissue responses to both medications. In vitro studies showed that ozone was effective over most of the bacteria found in cases of pulp necrosis. Ozone works best when there is less organic debris remaining. Therefore, the recommendation is to use either ozonated water or ozone gas at the end of the cleaning and shaping process. Ozone is e effective when it is used in sufficient concentration, for an adequate time. Ozone will not be effective if too little dose of ozone is delivered or it is not delivered appropriately.[18]

Use in prosthodontics

The effect of ozonated water on oral microorganisms and dental plaque was assessed. Few oral microorganisms and no viable C. albicans were detected after exposure to flowing ozonated water (2 or 4 mg/L) for 1 min, suggesting the application of ozonated water might be useful in reducing the number of C. albicans on denture bases. One study compared the microbicidal effect between gaseous ozone and ozonated water on dentures and found that direct exposure to gaseous ozone was more effective.[19]

Ozone in pedodontics

The basic actions of ozone in almost all branches of dentistry have been discussed so far. The applications of ozone therapy in a pediatric practice rely mainly on the fact that ozone application is a very quick, effective, easy and especially a painless procedure to perform. These aspects of the treatment not only enhance the operator efficiency but also effectively improves the patient compliance and tolerance to the treatment procedure. Attaining a positive rapport with a child patient is the key to a successful pediatric treatment which can be very effectively accompanied by using ozone therapy. Dahn Hardt et al.[20] treated open carious lesions with ozone in anxious children. There was near total reduction (93%) of dental anxiety. The frequently encountered cases in a pediatric practice are those of trauma to the teeth. A high level of bio compatibility of aqueous ozone on human oral epithelial cells, gingival fibroblast cells, and periodontal cells has been observed. Ozonated water is indicated in replantation of avulsed tooth without any harmful effect on periodontal cells.

Ozone in orthodontics

Teeth bonded with bonding material are reported to have been affected by some form of enamel opacity after orthodontic treatment; diffuse opacity being the most common type identified. Also visible white spot lesions have been seen to develop within 4 weeks of orthodontic treatment. Although enamel bracket interface is the most susceptible area for white spot lesion formation, microleakage can invade beneath the bracket area. Thus, enamel prophylaxis is of great importance in orthodontics. [21] Ghobashy et al. evaluate the effects of ozonized olive oil gel in reducing enamel demineralization around orthodontic bracket during orthodontic treatment. The use of ozonized olive oil gel in addition to the standard oral hygiene regimen was found to show significantly less decalcification of teeth among orthodontic patients. On the other hand, due to its strong oxidizing effect, ozone might have negative effects on resin tooth adhesion related to the oxygen inhibition of polymerization. In a recent study, [22] Cehreli SV et al. studied the effects of prophylactic ozone pretreatment of enamel on shear bond strength of

orthodontic brackets bonded with total or self-etch adhesive systems. They concluded that enamel pretreatment with ozone did not affect the shear bond strength of adhesive systems used for bracket bonding. Moreover, shear bond strength values of the ozone pretreated specimens were somewhat higher.

Conclusion

Ozone therapy has a wide range of applications in almost every field of dentistry. Its unique properties include immunostimulant, analgesic, anti-hypnotic, detoxicating, antimicrobial, bioenergetic and biosynthetic actions. Its atraumatic, painless, non-invasive nature and relative absence of discomfort increase patient's acceptability and compliance thus making it an ideal treatment choice specially for pediatric patients.

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