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Ozone in dentistry: An update

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Abstract
Ozone has been used successfully for the management of various diseases for more than a decade. It has unique properties that includes immunmodulation, analgesic, detoxicating, antimicrobial, bioenergetic and biosynthetic actions. Application of ozone is painless, non-invasive in nature, and relative absence of discomfort and side effects increase the patient's acceptance and compliance thus making it an ideal treatment choice specially for pediatric and apprehensive patients. Present review aims to highlight various application of ozone therapy in dentistry and its possible clinical applications in future.

Keywords: ozone therapy, dentistry, pediatric dentistry, dental caries

Introduction

Ozone as medicament was used during World War II to treat wounds, trench foot, gangrene and effects of poisonous gas. The use of ozone therapy has been advocated in dentistry for the past 6 decades. Results indicated that ozone treatment can have an inhibiting effect on the development of pit and fissure caries, as well as on root surface caries and proximal carious lesions [1]. Studies have shown ozone's effect on dental caries and primary root caries, periodontal infection, disinfection of denture surfaces, wound healing and as an antimicrobial, antiviral, and antifungal agent in the oral cavity [2, 3]. Application of ozone is painless, non-invasive in nature, and relative absence of side effects and discomfort increase the patient's acceptance and compliance thus making it an ideal treatment choice specially for pediatric and apprehensive patients [4]. Present review aims to highlight various application of ozone therapy in dentistry and its possible clinical applications in future**.**

Properties of ozone

Ozone exits as colorless gas, with a pungent odour at room temperature, detectable even at concentrations as low as 0.02–0.05 ppm [5]. Its half-life varies with variation in temperature. At 20 °C it has a half-life of 40 min at 0 °C about 140 min [6].

Production of ozone

Medical grade ozone is a mixture of pure oxygen and pure ozone in the ratio of 0.05% to 5% of O3 with 95% to 99.95% of O2. Due to the instability of the O3 molecule, medical grade ozone must be prepared immediately before use. Within less than an hour after preparation, only half of the mixture would remain as ozone while the other half would be transformed into oxygen [7]. In clinical settings, ozone generators are used to produce ozone from medical oxygen via an electrical field that simulates the natural production of ozone at the time of lightening [8].

Mechanism of action of ozone

Ozone is a highly unstable compound that brake into pure oxygen depending on temperature and pressure [9].

a. Antimicrobial action [10]

- Firstly, damage to the cytoplasmic membrane of microbial cells as a consequence to ozonolysis of dual bonds and secondly modification of intracellular contents because of secondary oxidant effect that leads to oxidation of protein loss of organelle function.
- All vital functions of bacteria (incapable of developing any self-immunity) are inhibited as a result of few seconds application of ozone.
- Ozone has wide range of antimicrobial action that leads to destruction of bacteria, fungi, and viruses.
- Oxone has antioxidative ability the human body cells are not damaged and the action selective to microbial cells.
- Ozone is more effective on Gram-positive bacteria are than Gram-negative bacteria.

b. Immunostimulating effect [11]

- Ozone has immunomodulation action on host body. The immunocompetent cell proliferation and immunoglobulin synthesis is stimulated as an influence of ozone to cellular and humoral immune system.
- The function of macrophages is activated due to which sensitivity of microorganisms to phagocytosis is increased.
- This further leads to production of cytokines as a consequence other immune cells are activated.
- Biologically active substances such as interleukins, prostaglandins, and leukotrienes, which help in reduction of inflammation and wound healing are synthesized by ozone.

c. Anti-hypoxic effect [11]

- Ozone results in change of cellular metabolism by raising partial pressure of oxygen in tissues and improving the transportation of oxygen in blood.
- Certain enzymes such as dehydrogenase, glutathione peroxidases and catalases are activated by repetitive low doses of ozone.

d. Biosynthetic effect [11]

- Ozone causes activation of protein synthesis mechanism with increased amount of mitochondria and ribosomes in cells that leads to elevation of functional activity and regeneration potential of tissues and organs.

e. Vasodilators (nitric oxide) that are responsible for dilatation of arterioles and venules are secreted by ozone [11].

f. Ozone intensifies remineralisation potential when acting on the organic substance of mineralized tooth tissues [11].

g. Also enables the diffusion of calcium and phosphorus ions to the deeper layers of carious cavities by opening of the dentinal tubules [12].

Use of Ozone in Dentistry

Ozone has a wide range of application in dental diseases. Ozone has been used for management of early carious lesions, sterilization of carious lesion, desensitization of sensitive teeth, root canals disinfection, periodontal disease and infection. Ozone also promote epithelial wound healing such as aphthous ulcer, herpetic lesions, bleaching of discoloured root canal treated teeth, treatment of peri-implantitis, irrigation of extraction sockets and as a rinse for the avulsed teeth or as a denture cleaner and decontamination of used dental instruments [13].

Ozone in Dental Caries

Ozone in gaseous and aqueous form has a disruptive effect on cariogenic microorganism like streptococcus mutans and streptococcus sobrinus. Ozone can convert acid produced by cariogenic microorganism into to acetic acid which can buffer the cariogenic acid and promote remineralisation of the carious lesion [14]. It has been suggested that the application of ozone to carious dental lesions will reverse these lesions and provide an alternative to conventional drilling and filling [15].

Ozone in Aphthous Ulcer

Recurrent aphthous ulceration is a common mucosal disorder that can be painful and debilitating for the patients. The topical application of ozone provided an effective means of producing resolution of clinical symptoms related to aphthous ulceration [13].

Ozone in Dentin Hypersensitivity

Exposure of dentinal tubules with related symptoms of sensitivity is an extremely common problem in common dental practice that can be effectively managed by ozone therapy [13].

Ozone in Halitosis

In more than 90% of all the cases, the origins of bad breath are found in the mouth and not in the stomach area. Quite often the bad breath of the patient is accompanied by periodontal disease. Ozone treatment totally corrects the halitosis [13].

Ozone in Prosthodontics

Ozone can be applied for cleaning the surface of removable partial denture. Denture stomatitis can be controlled by topical application of ozonated oil over tissue surface and over denture surface [16].

Ozone in Bleaching

Ozone can be successfully used for the bleaching of root canal treated tooth. Conventional 'walking bleaching' requires much more time and results are not often satisfactory. Moreover, whitening more severe stains, such as those caused by systemic ingestion of tetracycline, constitutes a challenge. Ozone can be successfully used for lightening the yellowish tinge of tetracycline-stained rat incisors [17].

Use in Paediatric Dentistry

Ozone can be used in the treatment of temporary arrest of caries progression in primary teeth or permanent teeth [13].

Ozone in Oral Surgery

Ozone therapy has a vast range of applications in oral surgery; be it a simple extraction procedure or a severe jaw infection or osteotomy procedures. Ozone enhances wound healing, improves several properties of erythrocytes and facilitates oxygen release in the tissues. This causes vasodilatation and hence improves the blood supply to the ischemic zones. Therefore, it can be successfully used in cases of wound healing impairments following surgical interventions like tooth extractions or implant dentistry [18].

Ozone Toxicity

Ozone inhalation can be toxic to the pulmonary system and other organs. Known side-effects are upper respiratory irritation, rhinitis, cough, headache, occasional nausea, vomiting, shortness of breath, blood vessel swelling, poor circulation, heart problems and at a time stroke [19]. If ozone intoxication occurs the patient must be placed in the supine position, and treated with vitamin E and n-acetylcysteine [20].

Conclusion

Ozone therapy has a wide range of applications in almost all branches of dentistry. It has unique properties that includes immunmodulation, analgesic, antihypnotic, detoxicating, antimicrobial, bioenergetic and biosynthetic actions. Application of ozone is painless, non-invasive in nature, and relative absence of discomfort and side effects increase the patient's acceptance and compliance thus making it an ideal treatment choice specially for pediatric and apprehensive patients.

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