MAVEN

REVIEW ARTICLE

OZONE IN DENTISTRY

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Abstract

Ozone (O3), also known as triatomic oxygen, is a naturally occurring compound consisting of three oxygen atoms. Ground level ozone is an air pollutant with harmful effects on the respiratory system; in the upper layers of the atmosphere it filters the potentially damaging UV light from reaching the earth's surface. In the era of antibiotic resistance, we need a naturally occurring substance like ozone to treat infection without any toxicity. The versa- tility of ozone therapy, its unique properties, noninvasive nature, are responsible for its wide spread use in the various fields of dentistry. The purpose of this article is to understand its mechanism of action and specific uses in the practice of dentistry. (2018, Vol. 02; Issue 01: Page 43 - 47)

Keywords: Ozone, Triatomic, Toxicity, Noninvasive.

Introduction

The word ozone originates from the Greek word ozein, which means odor and was first used in 1840 by German chemist Christian Friedrich Schonbein "The father of ozone therapy" (1). Ozone is a natural allotrope of oxygen. Its molecular weight is

47.98 gm/mol. It is a blue gas, with strong odor. It is a thermodynamically unstable compound that depending on the temper- ature & pressure decomposes to pure ox- ygen with a short half-life. Ground level ozone is an air pollutant with harmful ef- fects on the respiratory system. Ozone in the stratosphere filters potentially damag- ing ultraviolet light from reaching the earth's surface (2). In nature, ozone is formed by combination of oxygen in the air, under the influence of factors such as UV radiation, electrical discharge, and in- tense physical stress on water (3).

Structure

The structure of ozone consists of 3 oxy- gen atoms, bound by equal oxygen-oxygen bonds at an obtuse angle of 116°8' (Fig 1). The steric hindrance prevents it from forming a triangle with each oxygen atom forming the expected 2 bonds (4). Instead each oxygen forms only one bond with the remaining negative charge being spread throughout the molecule.

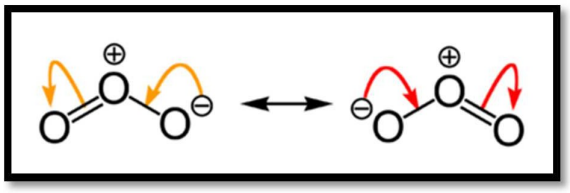

Fig 1: Ozone

Mechanism of action

Ozone therapy has a wide range of appli- cations in treating various diseases owing to its unique properties including antimi- crobial, immunostimulant, analgesic, an- tihypnotic, detoxicating, bioenergetic and biosynthetic actions (2).

Antimicrobial action

Ozone acts by damaging the bacterial cell membranes by ozonolysis and oxidates in- tra cellular proteins leading to loss of or- ganelle function (5). this action of ozone is selective to microbial cells and thus does not affect human body cell as the later have good antioxidative ability. Only un- healthy cells like cancer cells which have lost their protective mechanism and or- ganisms such as bacteria, viruses, fungi and parasites which are devoid of antioxi- dants are destroyed (3).

Anti- inflammatory and analgesics

Ozone stimulates release of interleukins, leukotrienes and prostaglandins. Infection or inflammation is positively charged and ozone is negatively charged reducing pain and inflammation (6).

Immune stimulating action

The electromagnetic action of ozone reac- tivates the immune system through lym- phocytes producing interleukins, macro- phage activation and cytokine release which in turn boost immune system; hence making it useful in patients with low immune status and immunodeficiency (7).

Anti – hypoxic action

Ozone causes secretion of nitrous oxide, vasodilator. It prevents clumping of red blood corpuscle and increases partial pressure of oxygen. It also activates aero- bic processes like glycolysis and Krebs cy- cle at cellular level thus stimulating circu- lation of blood and hence used in treat- ment of circulatory disorders.

Bioenergic and biosynthetic action

Ozone activates mechanisms of protein synthesis, increases amount of ribosomes and mitochondria in cells, thus increasing regeneration potential of tissues (8).

Production of ozone

The most common methods of ozone pro- duction used for therapeutic purposes are given below.

• Ultra-Violet System: Useful for purifying air but generates less concentration of ozone.

• Cold Plasma System: Useful for purifying water and air.

• Corona Discharge System: Most popular systems in medicine and dentistry. It has controlled production rate and easily gen- erates high ozone concentration (9).

Forms of ozone

Ozone may be available in 3 forms-(2)

1. Ozone gas
2. Ozone oil
3. Ozonated water

Application of ozone in dentis- try

ORAL MEDICINE

1. In the treatment of oral viral le- sions— Ozone has a potential of stimulat- ing antibodies and cytokines in body thus helping in the treatment of herpes simplex

and herpes zoster infections. It also neu- tralizes herpes virions and prevents bacte- rial super infection (1).

2. In the management of Temporo-mandibular joint disorders (articulation and inflammatory diseases) — Ozone gas is used because of its bio stimulation and anti-inflammatory effects (1).

3. In treatment of soft tissue lesions (all kinds of infectious, inflammatory, traumatic, burns, wounds & soft tissue le- sions including aphthae, denture stomati- tis) – Ozone has a disinfectant healing properties which are brought to use here (1).

4. In the management of Chronic mandibular osteomyelitis - Macedo and Cardoso described a case report of the ap- plication of ozonated oil on mandibular os- teomyelitis and demonstrated faster heal- ing times than conventional protocols as ozone has a positive influence on bone metabolism and reparative process of the bone and moreover it promotes complete and rapid normalization of non-specific re- sistance and T-cellular immunity (10). ENDODONTICS

1. Dental caries: Ozone is used in the treatment of early tooth, pit and fissure and proximal caries. Reversal of caries is associated with remineralisation and a corresponding reduction in acidogenic and aciduric microorganisms. Ozone en- hances the remineralisation of the carious lesion by killing the microorganisms by damaging their cell membrane, so that the local PH is raised. Being a powerful oxi- dant, ozone has the ability to remove pro- teins in the carious lesion and enable cal- cium and phosphate ions to diffuse through the lesion (11).

2. It is used for disinfecting root ca- nals and dentinal tubules. Ozone is effec- tive against E.Faecalis, Candida albicans etc. The ozonated air can get to the nar- rowest places in the canal and periapical region where conventional liquids may not be able to reach, disinfect the area and ac- celerate healing.

3. Bleaching: Strong oxidizing proper- ties causes tooth whitening- ozone helps in breaking the bonds which makes the enamel lighter in colour and helps in bleaching.

4. In the treatment of dentinal hyper-sensitivity- Ozone removes the smear layer, opens up the dentinal tubules, broadens their diameter and allows cal- cium and fluoride ions flow into tubules easily, deeply and effectively to plug den- tinal tubules, preventing the fluid ex- change through these tubules (3). PERIODONTICS

1. Effective in the treatment of halito- sis and ANUG— Ozone reduces the re- quirement of antibiotics as the region is disinfected locally.

2. Inhibition of dental plaque for-mation— Ozonated water can be used in the ultrasonic water reservoir, also as a pretreatment rinse before scaling, root planning and the sulci, pockets are irri- gated using syringe and canula in non- surgical pocket curettage. This process will reduce the initial pathogenic load on the patient locally and systemically. After treatment, each pocket & sulcus is insuf- flated with ozone gas which directly goes into tissues, sterilizing the area (3). IMPLANT DENTISTRY

1. Helps in bone regeneration

2. Used in sterilization and prevents infection— A sterile implant surface is necessary pre condition for the successful treatment of periimplantitis. Ozone can easily be applied with the available sili- cone cups, where long supragingival abut- ments are found, two silicone cups can be

attached on the top of each other to gen- erate vacuum (11).

ORHTODONTICS

1. Fixed orthodontic devices are par- ticular retention niches for a cariogenic biofilms.

Therefore patient undergoing an active or- thodontic treatment must be regarded as high caries risk patient (11).

Contraindications (8, 12)

- Pregnancy
- Glucose 6 phosphate dehydrogenase de- ficiency
- Hyperthyroidism
- Severe anemia
- Severe Myasthenia
- Acute alcohol intoxication
- Recent Myocardial Infarction
- Haemorrhage from any organ
- Ozone allergy

Ozone toxicity

- Ozone gas should not be inhaled as the bronchial pulmonary system is very sensi- tive to ozone.
- Ozone should not be administrated I.V as there would be a risk of air embolism.
- Other side effects include
- Epiphora
- Upper respiratory irritation
- Rhinitis, Cough, Nausea
- Vomiting,
- Shortness of breath,
- Blood vessels swelling,
- Heart problems
- Stroke.

In the event of ozone intoxication patient must be placed in SUPINE POSITION and treated with Vitamin- E, ascorbic acid, N- acetyl cysteine and inhaled humid oxygen (9).

Conclusion

Ozone is used in almost all aspects of den- tistry. There are good evidence of ozone bi- ocompatibility, and effectiveness in re- moving the microorganisms from dental unit water lines, the oral cavity, and den- tures. There are various advantages of ozone therapy as it is a biological and at- raumatic treatment modality. Therapeuti- cally it acts as a stimulant on the circula- tory system which makes it a good treat- ment modality of medical pathologies, the cost effectiveness is another good property of ozone. Further research in ozone would bring a revolution in dental practice.

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