



OZONE- A REVIEW

Periodontology

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ABSTRACT

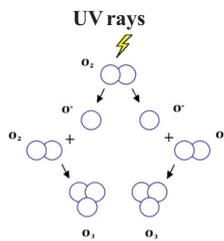
Ozone has been successfully used as a therapeutical agent for the treatment of various diseases. In spite of achieving many positive results its clinical use remains controversial. In dentistry it is used for the treatment of gingival and periodontal diseases, peri-implantitis, infection control, hypersensitivity, temporomandibular disorders, radiotherapy induced mucositis, lichen planus etc. The aim of this short review is to discard skepticism regarding ozone therapy and to explain its biological actions and uses.

KEYWORDS

Ozone, Immunostimulating

INTRODUCTION

Ozone, an allotropic form of oxygen (triatomic oxygen) is found as a natural gas in the stratosphere¹. Ozone is present at levels less than 20 µg/m from earth's plane making life possible. When UV rays strike oxygen, the two oxygen atoms split apart. These atoms then individually collide with O₂ to form O₃ in agreement with the Chapman theory¹.



Formation OF Ozone

O₃ is also produced in nature during the electric discharge of lightning. It is very beneficial in the stratosphere layer as it absorbs dangerous B and C ultraviolet radiations. It is toxic for the pulmonary tract when mixed with carbon monoxide (CO), N₂O₂ and traces of acids. **The US Clean Air Act** has set an ozone level of 120mg/m³ as an 8hr mean concentration to protect the health of workers. Medical grade ozone is a mixture of pure O₂ and O₃ in the ratio of 0.1% to 5% of O₃ and 95% to 99.5% of O₂². Industrial ozone is produced from air but medical ozone must be generated ex tempore only by using medical oxygen because otherwise the simultaneous generation of nitric dioxide (NO₂) will be very toxic³.

Historical Review

The use of ozone therapy dates back to 1800s. **Christian Friedrich Schonbein**, in 1839, noticed the emergence of a pungent gas with an "electric smell." He called it "ozone".

In 1896 the genius **Nikola Tesla** patented the first O₃ generator in the US and later formed the **'Tesla Ozone Company.'**

Ozone was first used during World War I for treating German soldiers affected by gaseous gangrene due to Clostridium anaerobic infections. **Stoker** reported the first 21 medical cases successfully treated with ozone.

In 1932, ozonated water was used as a disinfectant by **EA Fisch**, a Swiss dentist. Later, a surgeon, **Dr. E Payr (1871–1946)** had to be treated for a gangrenous pulpitis and remained astonished by the result. He, then extended its application to general surgery. The first ozone generator for medical use was developed by **Joachim Hünslner**, a German physicist and **Hans Wolff**, a German physician in 1957.

The Ozone Dogma

There was a dogma that "ozone is toxic any way you deal with it,"

creating the concept that ozone should not be used in medicinal field. In some countries, quacks without any medical qualification, inject ozone intravenously, a procedure prohibited since 1984 in Germany because of the risk of pulmonary embolism and death. This situation has generated a sort of crusade against ozone therapy in spite of the fact that ozone is considered one of the best disinfectants capable of preventing infection outbreaks⁴. Interestingly, **Paracelsus (1495–1541)** did not know biochemistry but guessed that "all things are poison and nothing is without poison, only the dose permits something not to be poisonous."

Behaviour Of Ozone

Among oxidant agents, it is the third strongest, after fluorine and persulphate. **Wentworth et al. (2003)** have postulated that in atherosclerotic patients human endothelium cells may produce ozone⁵. Normal or neoplastic cells in culture, are very sensitive to ozone even if the gas has a very low concentration⁶. Culture media have a significantly lower level of antioxidants than plasma⁷. At variance with blood, the eyes and the lungs are very sensitive to ozone because they have minimal antioxidant and neutralizing capabilities and therefore ozone should never contact these organs⁸.

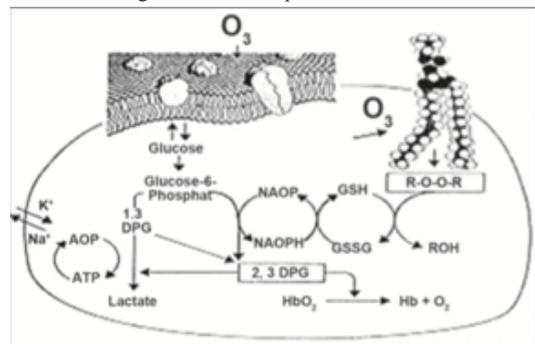
BIOLOGICAL MECHANISMS ELICITED BY OZONE

Antimicrobial Action

At low concentration of 0.1 ppm O₃ causes inactivation of bacterial cells and their spores. It inhibits cell growth at certain stages of fungi, budding are highly sensitive. In virus, it damages the viral capsid and disturbs the reproductive cycle. Ozone cannot inactivate bacteria, viruses, and fungi in vivo because the pathogens are well protected inside the cells by the powerful antioxidant system⁹.

Metabolism

Ozone therapy leads to an increased red blood cell glycolysis rate. This in turn leads to the stimulation of 2,3-diphosphoglycerate leading to an increase in the amount of oxygen released to the tissues. Ozone activates the Krebs cycle. It enhances the production of enzymes like glutathione peroxidase, catalase and superoxide dismutase which act as free radical scavengers and cell wall protectors¹⁰.



Action Of Ozone on RBC metabolism¹⁰

Activation Of Immune System¹¹

It stimulates proliferation of immunocompetent cells. The function of macrophages is activated due to which sensitivity of microorganisms to phagocytosis is increased. Biologically active substances such as interleukins, prostaglandins, and leukotrienes, are synthesized.

Anti-Inflammatory Action

Ozone is anti-inflammatory. These effects are due to decrease in the production of mediators of the inflammation. The infection or inflammation is positively charged (acidic) and ozone is negatively charged (basic) so the chemistry of infection and inflammation attracts ozone to the area¹².

Applications of Ozone in Dentistry

Ozone is a very good alternative and/or an additional disinfectant to standard antiseptics. According to **Krammer (1983)**,¹³ a German dentist, aqueous ozone can be used:

1. As a powerful disinfectant.
2. To control bleeding.
3. To cleanse wounds in bones and soft tissues.
4. To improve healing by increasing the local supply of oxygen.
5. To increase the metabolic processes related to wound healing

Uses in Periodontics

The use of ozonized solutions for complex treatment of inflammatory diseases of periodontium was studied by **Sorokina and Zaslavskaja in 1997**¹⁴. Both gaseous and aqueous ozone are used as an adjunct to mechanical debridement. **Ebensberger et al. (2009)**¹⁵ evaluated the effect of ozonated water on the proliferation of cells in the periodontal ligament. They concluded that the 2 min irrigation of the avulsed teeth with ozonated water might lead to mechanical cleansing and decontamination of the root surface, with no negative effect on periodontal cells.

Nagayoshi et al. (2004) examined the effect of ozonated water on oral microorganisms and dental plaque. They confirm that ozonated water was effective in killing both gram positive and gram negative microorganisms. Also, ozonated water inhibited the accumulation of dental plaque in vitro¹⁶.

Matsumura et al. (2004) ozone does not have a major effect on stimulation of gingival cells for osteoblastic activity in the regeneration of the periodontium around implants¹⁷.

Ramzy et al. (2005) irrigated the periodontal pockets with ozonized water in patients with aggressive periodontitis. Improvement in clinical parameters was recorded in quadrants treated with SRP plus ozone application¹⁸.

Huth et al. (2007) examined the effect of ozone on the influence on the host immune response. They concluded that ozone exerts inhibitory effects on the NF-kappaB system, suggesting that it has an anti-inflammatory capacity¹⁹.

Kshitish and Laxman (2010) conducted a randomized split-mouth study on 16 patients suffering from generalized chronic periodontitis. The antifungal effect of ozone was pronounced. CHX did not demonstrate any antifungal effect.²⁰

Dodwad et al. (2011) compared the effect of oral irrigation with ozonated water, 0.2% Chlorhexidine and 10% Povidone iodine in patients with chronic periodontitis. The study concluded that local ozone application can serve as an antimicrobial agent²¹.

Irmgard et al. (2012) conducted an in vitro study on the influence of gaseous ozone in peri implantitis using titanium and zirconia. They concluded that gaseous ozone showed selective efficacy to reduce adherent bacteria on titanium and zirconia without affecting adhesion and proliferation of osteoblastic cells²².

CONCLUSION:

Ozone therapy being painless and non invasive is readily accepted by patients. Pulmonary toxicity due to prolonged inhalation of polluted air and many studies, performed in saline washed erythrocytes unprotected by the potent plasma antioxidants, have generated the dogma that 'ozone is always toxic and should not be used in medicine.' Thus only scientifically well-demonstrated advantages can eliminate this skepticism and generalize its use in medical and dental treatment.

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