CURRENT STATUS AND FUTURE POTENTIAL FOR OZONE THERAPY IN DENTAL MEDICINE

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ABSTRACT:

Introduction. Recently, ozone's therapeutic effectiveness and toxicity have come under scrutiny and increased attention. Ozone, like oxygen itself, is undeniably one of the most powerful oxidants. Ozone has antibacterial and immunostimulatory actions, making it a good choice for treating gingival and periodontal disorders. The purpose of this article is to offer a comprehensive overview of ozone's dental clinical uses.

Key words: *ozone, Anti-hypoxic, immunostimulating, oxidizer, etc.*

BACKGROUND

Protecting our atmosphere from harmful radiation, ozone (O3) is an allotropic type of oxygen gas that is often located in the stratosphere [1].

Ozone is an allotrope of oxygen with a third, unattached molecule that freely circulates in the air and destroys any abnormal, invading cells, including those of viruses, bacteria, fungus, and other microorganisms.Even healthy, normal cells become more stable.

In terms of therapeutic effectiveness and toxicity, ozone has recently been the target of criticism and attention. Ozone is, with oxygen, one of the most powerful oxidants known to science [2,3].

In addition, ozone's application across such a wide range of medical fields as neurology, orthopedics, internal medicine, sports medicine, endocrinology, and others makes it hard to classify it as a therapeutic agent. This has the potential to create tensions between the various medical specialties and areas of application.Recent research has linked ozone to stomatology, a discipline formerly related with herniated discs [4] in the spine[5,6].

In light of modern pharmacological understanding, ozone may be viewed as a pro-drug that, when administered in safe levels, activates a second messenger in a cascade with many systemic effects. The closest analogy would be ischemic preconditioning [7].

Low-dose ozone has been shown to have remarkable effects in many pathological situations by modulating antioxidant enzymes, nitric oxide pathways, and other subcellular activities.

HISTORY

In 1870, Landler began employing ozone as a medical treatment after it had been discovered by Christian Frederick Schonbein at the University of Basel in Switzerland. Yet, it wasn't until 1932 that ozonated water was utilized as a disinfectant by Dr. E. A. Fisch, [8] a Swiss dentist, and the scientific world took notice of ozone's potential benefits.

In his work, Fisch pioneered the use of ozone, initially as a gas and then as ozonated water. As luck would have it, a surgeon named Dr. E. Payr (1871-1946) with gangrenous pulpite and was treated with local ozone.

He was thereafter amazed by the outcome. With great excitement, he pushed its use into general surgery. Hemostasis, increased local oxygen supply, and bacterial inhibition were all achieved with the use of ozonated water during dental surgery.

OZONE GENERATORS

Producing ozone gas can be done in one of three ways:

•Ultraviolet System: produces low concentrations of ozone

•Cold Plasma System: used in air and water purification.

•Corona Discharge System: produces high concentrations of ozone.

Pure ozone and oxygen are combined in a medical grade ozone mixture at a ratio of 0.05% to 5% O3 and 95% to 99.95% O2. Since the O3 molecule is so unstable, medical grade ozone needs to be made right before it's used. Less than an hour after preparation, half of the mixture is still ozone and the other half has been converted to oxygen [9].

LITERATURE REVIEW

The following are some of the applications of ozone that were proposed by German dentist Fritz Kramer [10].

1.effective antiseptic;

2.as a means of stopping bleeding

3. effective at disinfecting bone and soft tissue lesions

Ozone helps wounds heal faster because it increases the local oxygen supply to the injured region.

Five, ozonated water can raise local wound temperatures, which in turn speeds up the metabolic processes involved in healing wounds[10].

►*biological effects*

Ozone's physicochemical qualities are what initially led to its use in dentistry. Ozone has a number of biological effects on humans, including immunostimulatory and analgesic effects, antihypoxic and detoxicating properties, antibacterial activity, and bioenergetic and biosynthetic (activating the metabolism of carbohydrates, proteins, and lipids) effects [9].

►*ozone in the management of caries*

To determine whether or not 40 s ozone gas (HealOzone[KaVo Dental GmbH, Germany]) can halt the development of non-cavitated early occlusal fissure caries, Huth et al. recently undertook a split-mouth randomized controlled clinical research [11,10].

The effectiveness of ozone gas in the reversal of caries in open single-surface lesions was evaluated in a single clinical study. In this study, 82 open single-surface lesions were excavated until a leathery consistency was recorded in 28 anxious and non-treatable children (mean age 5.96± 2.36 years); the larger lesion was exposed to 20 s ozone gas (HealOzone) and the smaller lesion was left untreated as a control. [13,14].

Ozone gas (HealOzone) was recently evaluated for its efficacy in the treatment of pit and fissure caries, as well as root caries, in a recent systematic review by Brazzelli et al.[15].

They arrived at a result that was consistent with that of the Cochrane library. The researchers used a Markov model to compare the existing treatment for tooth caries over 5 years with HealOzone and determine whether there is a cost savings. Current management plus HealOzone was associated with higher costs than current management alone for non-cavitated pit and fissure caries, but lower costs for non-cavitated root caries [16-18].

►*antimicrobial effect*

Ozone is very harmful to microorganisms including bacteria, fungus, and viruses. Ozone's antimicrobial effects come from the cell damage it causes by ozonolysis of dual bonds in the cytoplasmic membrane and the secondary oxidants' alteration of intracellular contents (oxidation of proteins, loss of organelle function)[19].

While being very effective against microbes, this action has little to no effect on human cells due to the latter's powerful anti-oxidant defenses.
Antibiotic-resistant microorganisms are no match for ozone's potency. Antimicrobial effectiveness is enhanced in an acidic liquid environment. The mechanism of ozone action in viral infections involves the intolerance of infected cells to peroxides and the modification of the function of reverse transcriptase, which is involved in the creation of viral proteins [20,21].

►*Ozone in oral microbiology*
It's possible that ozone can reduce the number of bacteria in tooth plaque that cause oral infections. However, the available evidence is conflicting; some studies found that ozone (in either aqueous or gaseous form) was ineffective in completely wiping out the live bacteria,while others found that ozonated water was effective in eliminating gram-positive and gram-negative oral microorganisms as well as oral Candida albicans [22,23].
Aqueous ozone has been discovered to be very biocompatible with human oral epithelial cells, gingival fibroblast cells, and periodontal cells [24]. It's crucial to clean up knocked-out teeth before replanting them.

►*Immunostimulating Effect*
The cellular and humoral immune systems are affected by ozone. It increases the production of immunoglobulins and the number of cells able to mount an immune response. Moreover, it improves the ability of macrophages to phagocytose bacteria.
The body's immune cells release specialized messengers known as cytokines in response to this stimulation by ozone. The subsequent activation of additional immune cells by these chemicals stimulates the immune system as a whole to fight off illness. Patients with a low immunological state and/or immune deficiency benefit greatly from medical ozone treatment since it stimulates their immune systems [25].
►*Biosynthetic Effect*
Protein synthesis is triggered, and cellular ribosome and mitochondria content are both enhanced. Improved tissue and organ function and regeneration can be traced back to these cellular modifications [26,27].

►*Ozone in prosthodontics*
The physical features of healthy enamel, such as the knoop surface microhardness or contact angle, are unaffected by the application of ozone gas as a preventative therapy prior to etching and the insertion of sealant.
Longer exposure to ozone gas has no detrimental effect on dentin and enamel shear bond strength to adhesive restorations, and it has a significant bactericidal effect on microorganisms within the dentinal tubules of deep cavities, which might increase the clinical effectiveness of restorations [28,29].
Surfaces of removable partial denture alloys may be cleaned with ozone without negatively affecting the alloy's reflectivity, surface roughness, or weight [30,31].

►*ozone in periodontal disease*
The effects of ozone therapy on bacterial cell proliferation and ultra-structural alterations were studied by Thanomsub et al. in 2002. (Escherichia coli, Salmonella sp., Staphylococcus aureus and Bacillus subtilis). It has been shown that water polluted with up to 105 cfu/ml may be sterilized with ozone at a rate of 0.167 mg/min/l in about 30 minutes. The bacterial cell membrane was found to be destroyed, leading to intercellular leaking and ultimately leading to cell lysis [32].
In 2002, Ebensberger et al. studied how irrigating newly removed, fully erupted third molars with ozonated water affected the growth of cells in the periodontal ligament adhering to the root surfaces. They found that rinsing avulsed teeth for 2 minutes in non-isotonic ozonated water might result in both mechanical cleaning and decontamination of the root surface, without harming the surviving periodontal cells [33].
In 2003, Holmes studied the effects of the Kavo healozone device on Primary root carious lesions (PRCL), which were then treated with a remineralizing solution

including xylitol, fluoride, calcium, phosphate, and zinc. A total of 89 patients, ranging in age from 60 to 82, were treated with this method. One hundred percent of PRCLs treated with ozone showed considerable improvement after 18 months. Just one PRCL showed improvement in the untreated lesions control group. Whereas 62% of PRCLs maintained a leathery condition, 37% had degraded to a soft status [34,35].

Ozone-treated water was used to irrigate the periodontal pockets of 22 patients with severe periodontitis by Ramzy et al. in 2005. In a clinical 4-week research, patients had a blunt-tipped sterile plastic syringe filled with 150 ml of ozonized water irrigated into their periodontal pockets for 5-10 minutes once weekly. Pocket depth, plaque index, gingival index, and bacterial count all saw substantial improvements in the quadrants when scaling and rootplaning with ozone was applied. They found that areas treated with ozonized water had much less microbes [36,37].

PERSPECTIVES AND HYPOTESIS:

Ozone treatment, which has been around since 1840, is a promising new therapeutic option. Ozone is a popular therapeutic agent for the treatment of medical pathologies and infectious oral disorders due to its high antibacterial activity, ability to increase circulation, and ability to alter the immunological response. Several investigations have demonstrated that ozone has an oxidative effect on bacteria.

No significant degree of efficiency and cost-effectiveness has been reached in the therapeutic application of ozone. Lack of in vitro and in vivo, long term randomized controlled trials, and double blind research might account for the discrepancy in study results. To support the widespread application of ozone as a dental treatment modality, we still require the gold standard of proof, namely, well-designed, double-blind, randomized clinical studies. Studies with empirical backing imply that ozone may have use in dentistry.

CONCLUSIONS:

Finally, the research shows that there is limited clinical evidence for the use of ozone in dentistry, despite the encouraging potential suggested by laboratory investigations. In order to justify the routine use of ozone as a treatment modality in dentistry, the highest level of evidence is still required, such as well-designed, double-blind randomised clinical trials with adequate sample size, limited or no loss to follow up, and carefully standardized methods of measurement and analysis.

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