

**OZONE THERAPY: THE ALTERNATIVE MEDICINE OF FUTURE**Parva Jani\*<sup>1</sup>, Gunjan Patel<sup>1</sup>, Priti Yadav<sup>1</sup>, Lipsa Sant<sup>1</sup>, Hitesh Jain<sup>1</sup><sup>1</sup>Sigma Institute of Pharmacy, Baroda, Gujarat (India)\*Corresponding Author Email: [prvjani@gmail.com](mailto:prvjani@gmail.com)**ABSTRACT**

Ozone (O<sub>3</sub>) is a gas which is an allotropic and a more active form of oxygen which is found in nature in protective ozone layer in our atmosphere. Although ozone has dangerous effects, yet researchers believed that it may have therapeutic effects. Thus ozone therapy has been thoroughly studied for more than a century in various countries. Its effects were proved to be consistent, safe, with minimal and preventable side effects. Medical ozone has disinfectant and antiseptic properties. Ozone therapy acts as a form of oxygen therapy that stimulates mitochondria and gives them bath of fresh air. Diseases treated by Ozone therapy are infected wounds, circulatory disorders, geriatric conditions, macular degeneration, viral diseases, rheumatism/arthritis, cancer, skin healing and AIDS. Medication forms in a gaseous state are somewhat unusual and it is for this reason that special application techniques had to be developed for the safe use of ozone.

**KEY WORDS**

Ozone, Auto-hemotherapy, Inactivation, Peroxidation, Interleukin.

**INTRODUCTION**

Oxygen/ozone therapy is a term that describes a number of different practices in which oxygen, ozone or hydrogen peroxide are administered via gas or water to kill disease microorganisms, improve cellular function and promote the healing of damaged tissues<sup>1</sup>.

Oxygen is the most vital element required for human life and it is the key to good health. The best way to optimize health is to oxygenate every cell in our body. The more oxygen we have in our system, the more energy we produce and more efficiently we can eliminate wastes. Ozone is oxygen with an extra molecule added. It should be introduced in large quantities into the body so that the singlet oxygen molecule that is unattached and freely circulating will attack all immature, sick and deformed cells, which are foreign to the body, like viruses, bacteria, fungi etc. Thus, it increases the stability of normal good healthy cells.

**HISTORY**

In 1856, just 16 years after its discovery, ozone was first used in a health care setting to disinfect operating rooms and sterilize surgical instruments<sup>2</sup>. By the end of the 19th century the use of ozone to disinfect drinking water containing bacteria and viruses was well established in mainland Europe<sup>2, 3</sup>. In 1892 *The Lancet* published an article describing the administration of ozone for treatment of tuberculosis<sup>4</sup>. In 1902 another article was published claiming success in treating chronic middle ear deafness with ozone<sup>5</sup>. Ozone was used during the First World War to disinfect wounds<sup>6</sup>.

Ozone therapy has been in use since the 1800s and in 1896 the genius Nikola Tesla patented the first ozone generator in the US, later forming the 'Tesla Ozone Company'. After that the Institute for Oxygen Therapy-Healing was formed in Berlin and the man credited with founding

naturopathy, Dr. Benedict Lust, began practicing in New York, and wrote many articles on ozone. This form of treatment is highly popular in Germany and in 1959; an ozone machine called "Ozonosan" was patented by Dr. Joachim Hansler which formed the basis of the expansion in German ozone therapy<sup>1, 5, 7-9</sup>.

### OZONE IN NATURE

Ozone is a molecule consisting of three atoms of oxygen in a dynamically unstable structure due to the presence of mesomeric states<sup>10</sup>. It has a half-life of 40 min at 20°C and about 140 min at 0°C. Ozone is produced by lightening in nature and by pulsing high currents of electricity through medical grade oxygen. In nature it is abundant only in the stratosphere (20,000-30,000 m) where their concentration is about 16-20 mg/m. In this layer, it is produced by the action of ultraviolet solar radiation and in turn, protects the earth from ultraviolet solar radiation. In recent decades, photochemical pollution of the lower atmosphere, caused by degradation of petroleum gas and volatile combustion products of oil, coal etc. has led to much higher ozone levels, especially in cities. In the stratosphere, chlorofluorocarbons in liquid refrigerants and spray cans have destroyed part of the protective layer, causing a "hole" at the South Pole. These events are widely reported in the mass media<sup>11, 12</sup>.

### INDUSTRIAL PRODUCTION OF OZONE

The most widely used process for the production of ozone is based on the following reaction:



For production of ozone, oxygen flows across an electric arc having a potential difference of about 10,000 Volt in an ozone generator. All components of which must resist oxidation, because ozone is one of the strongest oxidizing agents known and attacks most plastics (except

polyethylene, polypropylene, silicone and teflon) and most ferrous materials (except stainless steel 316 and titanium). An ozone generator requires a photometer to monitor the ozone concentrations produced. They must also have a system for destroying unused ozone, which cannot be released into the atmosphere<sup>10-12</sup>. Ozone Generators use several technologies to produce ozone:

- UV lamp – makes small amounts of ozone and is unreliable in making accurate concentrations. They burn out easily.
- Corona discharge – dual dielectric sealed systems produce ozone but also produce lots of heat which is both destructive to ozone and to the machine.
- Cold plasma generators – which produce ozone using low level current passed in 2 tubes of a noble gas between which an electrostatic plasma field is formed that ionizes the oxygen<sup>13</sup>.

### METHODS OF ADMINISTRATION<sup>13, 14</sup>

1. Major auto-hemotherapy:  
Anticoagulated blood is mixed with ozone and is infused into a blood vessel. (It requires 200-250 ml of blood).
2. Minor autohemotherapy – Bloodmixed with ozone is injected intramuscularly. (It requires 5-10 ml of blood).
3. Direct IV infusion: Ozone slowly administered into a major vessel.
4. Ozonated water – Dissolves easily in water to be used topically or consumed.
5. Ozone in Saline – Can be used topically or given IV or SQ.
6. Rectal/vaginal insufflations –Humidified ozone is administered by catheter.
7. Intra-articular administration – For joint healing and prolotherapy.
8. Prolo/Sclerotherapy – Very good, less painful than other agents.

9. Acupuncture – With ozone, more effective than B<sub>12</sub>.
10. Ozonated olive oil – Ozone is bubbled through oil until the oil is thickened. This will produce ozonides that are not irritating and thus is applied topically even to eyes.
11. Inhalation – Ozone that has been bubbled through olive oil and humidified will not irritate respiratory epithelium.
12. Subconjunctival injection – For ulcers and keratitis sicca.
13. Gingival and tooth apex injection –Can eliminate infection.
14. Urinary bladder insufflations – For chronic inflammation.
15. Disc protrusions – Prolotherapy, which can be injected at interspinous space and around facets, stabilize joints and accelerate healing.
16. Auricular – Can be direct, humidified, or bagged with a homemade devicemade from IV bags and tubing.
17. Limb or body bagging – Body or parts are bathed in humidified ozone.

## MECHANISM OF ACTION

### A. Inactivation of bacteria, fungi, virus, yeast and protozoa:

Ozone therapy disrupts the integrity of the bacterial cell envelope through oxidation of phospholipids and lipoproteins. In fungi ozone inhibits cell growth at certain stages. In viruses, ozone damages the viral capsid and upsets the reproductive cycle by disrupting the virus to cell contact with peroxidation. The weak enzyme coating on the cells which make them vulnerable to invasion by viruses and make them susceptible to oxidation and elimination from the body, which then replaces them with healthy cells<sup>15, 16</sup>.

### B. Stimulation of oxygen metabolism:

Ozone therapy causes an increase in red blood cell glycolysis rate as shown in figure no.1. This leads to stimulation of 2, 3 diphosphoglycerate which leads to an increase in amount of oxygen released to the tissues. Ozone stimulates the Krebs's cycle by enhancing the oxidative carboxylation of pyruvate and stimulating the production of ATP. It also causes a significant reduction in NADH and oxidizes cytochrome C. There is a stimulation of production of enzymes which act as a free radical scavengers and cell wall protectors: glutathione peroxidase, catalase and superoxide dismutase. Production of prostacyline a vasodilator is also induced by ozone<sup>15</sup>.

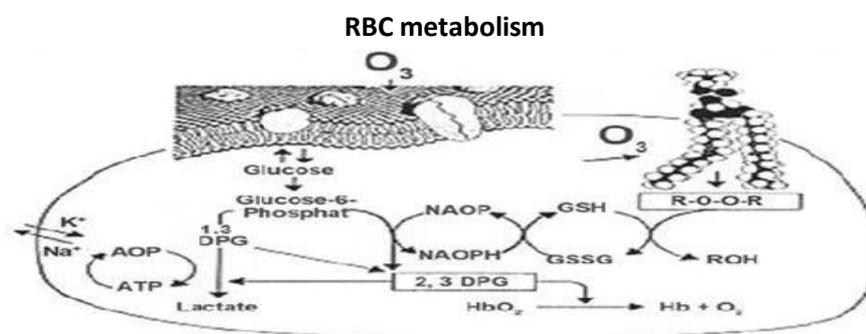


Figure 1 Effect of ozone on RBC metabolism.

### C. Activation of immune system:

Ozone administered at a concentration of 30 to 55  $\mu\text{g}/\text{cc}$  causes the greatest increase in the production of interferon and greatest output of tumor necrosis factor and interleukin-2. The production of interleukin-2 launches an entire cascade of subsequent immunological responses<sup>15, 17</sup>.

## APPLICATIONS OF OZONE THERAPY

### A. In wound healing

- Ozone ( $\text{O}_3$ ) has been widely recognized as one of the best bactericidal, antiviral and antifungal agents and it has been used empirically as a clinical therapeutic agent for chronic wounds, such as trophic ulcers, ischemic ulcers and diabetic wounds. The beneficial effects of  $\text{O}_3$  on wound healing might be assumed to be due to decreased bacterial infection, ameliorated impaired dermal wound healing or increased oxygen tension by  $\text{O}_3$  exposure in the wound area<sup>18-21</sup>.
- $\text{O}_3$  exposure is associated with activation of transcription factor NF- $\kappa$  B; this is important to regulate inflammatory responses and eventually the entire process of wound healing<sup>18, 21-23</sup>.
- A recent study has shown that hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) potentially induced the VEGF expression in human keratinocytes which can stimulate wound healing.  $\text{O}_3$  might enhance acute cutaneous wound healing, and this could be associated with growth factors such as FGF, PDGF, TGF- $\beta$  and VEGF. Ozonated oil has been used topically for the treatment of chronic wounds<sup>23</sup>.

### B. Dental application

- Periodontitis is a destructive inflammatory disease of the supporting tissues of the teeth and is caused either by specific microorganisms or by a group of specific

microorganisms, resulting in progressive destruction of periodontal ligament and alveolar bone with periodontal pocket formation, gingival recession, or both<sup>24</sup>.

- Bacteria are the prime etiological agents in periodontal disease, and it is estimated that more than 500 different bacterial species are capable of colonizing the adult mouth and the lesions of the oral cavity have an immense impact on the quality of life of patient with complex advance diseases.
- Three fundamental forms of application to oral tissue are applied — (1) ozonated water, (2) ozonated olive oil, and (3) oxygen/ozone gas. Ozonated water and olive oil have the capacity to entrap and then release oxygen/ozone, an ideal delivery system and are effective against wide spectrum of bacteria causing dental diseases. These forms of application are used singly or in combination to treat dental disease<sup>25</sup>.

### C. Treatment of cancer<sup>26</sup>

Cancer cells die when they are exposed to oxygen as they are anaerobic. Ozone fights cancer through a variety of mechanisms as shown in figure no. 2. Some of the anticancer effects of ozone include:

- Destruction of cancer producing pathogens.
- Oxidative destruction of xenoestrogens and other carcinogens.
- Increasing levels of immune stimulating and cancer fighting cytokines.
- Increasing levels of superoxide dismutase (SOD).
- Increasing white blood cell activity.
- Decreasing lactic acid levels preventing its conversion back in to glucose through gluconeogenesis.
- Direct destruction of cancer cells through an overload of peroxide within the cancerous cells.

### Action of ozone on cancerous cells

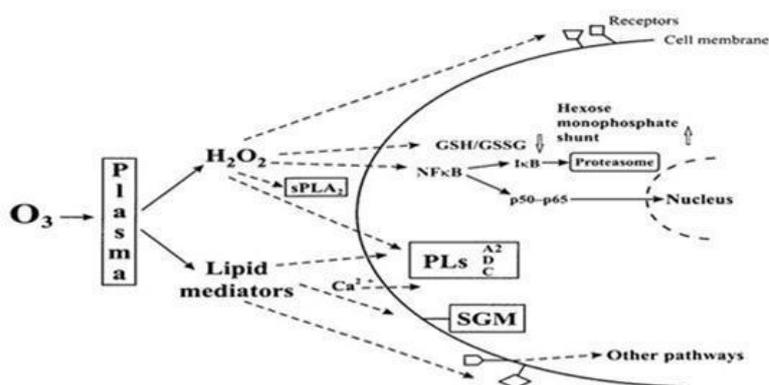


Figure 2 Pathways of destruction of cancerous cell.

#### D. Treatment of aids

##### (Acquired immunodeficiency syndrome)

- Ozone overcomes the AIDS virus by a fundamentally different process than usually attempted by drugs. Instead of burdening the liver and immune system with more elaborate toxic substances, ozone simply oxidizes the molecules in the shell of the virus<sup>27</sup>.
- The ozone is produced by forcing oxygen through a metal tube carrying a 300 volt charge. A pint of blood is drawn from the patient and placed in an infusion bottle. The ozone is then forced into the bottle and mixed in by shaking gently, whereupon the blood turns bright cardinal red. As the ozone molecules dissolve into the blood they give up their third oxygen atom, releasing considerable energy which destroys all lipid-enveloped viruses, and apparently all other disease organisms as well, while leaving blood cells unharmed.

#### E. Treatment of SARS

##### (severe acute respiratory syndrome)

Ozone is a naturally occurring energy-rich molecule embodying unique physicochemical and biological properties suggesting a possible role in the therapy of SARS, either as a

monotherapy or, more realistically, as an adjunct to standard treatment regimens. Owing to the excess energy contained within the O<sub>3</sub> molecule, it is theoretically likely that O<sub>3</sub>, unlike organism-specific antiviral options available today, will show effectiveness across the entire genotype and subtype spectrum of SARS<sup>16</sup>.

#### MERITS OF OZONE THERAPY<sup>28</sup>

- It improves circulation, oxygenates hemoglobin, kills parasites, corrects dizziness, neutralizes acid and overcomes weakness.
- It acts as cell energizer, vitality booster, immune enhancer, skin purifier, liver cleanser, blood purifier
- It kills viruses (ozone and hydrogen Peroxide)
- It improves the delivery of oxygen from the blood stream to the tissues of the body
- It speeds up the breakdown of Petrochemicals
- It increases the production of interferon and tumor necrosis factor, thus helping the body to fight infections and cancers.
- It increases the efficiency of antioxidant enzymes.

- It increases the flexibility and efficiency of the membranes of red blood cells.
- It speeds up the citric acid cycle, which in turn stimulates the body's basic metabolism.

### DEMERITS OF OZONE THERAPY<sup>29-32</sup>

- An array of ill-effects are observed owing to the reactivity of O<sub>3</sub> via oxidation, peroxidation or generation of free radicals and giving rise to cascade of reactions like peroxidation of lipids leading to changes in membrane permeability, lipid ozonation products (LOP) act as signal transducer molecules.
- The main reason for this being presence of unsaturated fatty acids in both lung lining fluid and pulmonary cell bilayers, O<sub>3</sub> reacts with unsaturated fatty acids to give their specific products i.e., LOP, which activates the lipases triggering the release of endogenous mediators of inflammation.
- The loss of functional groups in enzymes leading to enzyme inactivation. These reactions further results in cell injury or eventual cell death. Combinations of O<sub>3</sub> and NO<sub>2</sub> occur in photochemical smog, have hazardous effects on lung alveoli and act additively or synergistically.
- Dietary antioxidants or free radical scavenger like Vitamin E, C, etc. can prevent above mentioned effects of ozone.
- Adverse reactions of ozone that were revealed from the human studies are erythrocyte damage, hemolysis reduced glutathione concentration, reduced leukocyte viability, cytokine production and pancytopenia<sup>33,34</sup>.

### CONCLUSION

Ozone therapy can be used as an alternative therapy for treatment of various diseases as it

improves utilization of oxygen and stimulates release of growth factors that reduce ischemia in vascular disease; it activates the immune system and may kill cancer cells. The use of ozone as therapeutic agent should be done with excessive precautions as it may prove harmful to humans, when used in improper quantities. Thus research in this area should be done to improve effectiveness of the therapy and reduce adverse effects.

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