

Ozone Sterilizer for Treatment and Health Care

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Abstract

Ozone is a green broad-spectrum bactericidal disinfectant, and a trace amount of ozone in the atmosphere makes many viruses and bacteria lose their biochemical activity and infectivity. Nature produces trace amounts of ozone in the air through lightning to purify the ecological environment. The product of ozone decomposition is oxygen, without secondary pollution. Ozone sterilizer is widely used in the epidemic prevention and control of intensive breeding farms and achieved remarkable results. If the concentration and action time of ozone can be accurately controlled, then ozone can quickly eliminate pathogens, without harming the normal cells in the human body. How to use medical ozone for epidemic prevention, treatment and health care is a subject worthy of serious study, which should arouse the attention of the experts in the field.

Keywords

Medical Ozone, Ozone Sterilizer, Epidemic Prevention, Health Care, COVID-19, HIV

1. Introduction

Ozone O₃ is an allotrope of oxygen O₂, which is an unstable and light blue gas with a fishy smell. At room temperature, the half-life of ozone in 20°C water is only 16 - 25 minutes. As a chemically active molecule, ozone has an oxidation potential of 2.07 V, which is higher than that of hydrogen peroxide, chlorine dioxide, chlorine gas and permanganate [1]. In addition, ozone can also be converted in water to form a more active hydroxyl radical (-OH, oxidation potential of 2.8 V), which has a stronger oxidation effect [2]. Ozone is a broad spectrum of high-efficiency disinfectant, which reacts very quickly and can inactivate various

pathogens, such as bacteria, fungi and viruses [3] [4]. Ozone attacks proteins and lipids in the viral spiking synapses and envelope, disrupting viral integrity and thus inactivating the virus. Ozone chemically reacts with the bacterial cell wall and the proteins in it, rapidly entering the cell wall, oxidizing intracellular enzymes, RNA or DNA, thereby killing the pathogens [5] [6]. Ozone, as a disinfectant, can kill almost all pathogens and pathogenic microorganisms, including various viruses (such as hepatitis virus, influenza virus, norovirus and coronavirus), bacteria (such as *Escherichia coli*, *Staphylococcus aureus*, etc.), and bacterial spores. The mechanism of ozone disinfection includes a combination of chemical, physical and biological aspects. Ozone disinfection has no drug resistance, and the ozone sterilization speed is 300 - 600 times that of chlorine agents.

At present, the ozone production technology and process have been very mature, and the industrial method of ozone production is mainly the corona discharge method. With dry air or oxygen as a raw material, an ozone generator produces ozone, is used for disinfection and sterilization purposes. For different media, you can use ozone gas or ozone water for disinfection. Ozone has been widely used in indoor air disinfection, tap water disinfection, livestock epidemic prevention, sewage deep treatment and other occasions [7]. Compared with other disinfection methods, ozone disinfection has no harmful residue and secondary pollution, and air disinfection concentration distribution is uniform, easy to use and fast. Compared with the chlorine disinfection technology, the residual ozone gas can be decomposed into oxygen in a short period of time, thus greatly reducing secondary environmental pollution. Furthermore, ozone can be used for medical and health purposes, such as treatment of gynecological diseases, burn healing, herpes zoster, and prevention of epidemics. This is a very promising direction, and this paper mainly introduces some applications of ozone in this area.

2. Applications of Ozone in Treatment and Health Care

In China, there are many clinical studies on combining ozone and traditional Chinese medicine to treat some difficult diseases. For example, local ozone injection combined with nerve block is effective in the treatment of herpes zoster. Herpes zoster is caused by the varicella-zoster virus, and the course of the disease lasts about 3 - 4 weeks. 9% - 34% of patients with herpes zoster develop persistent post-herpetic neuralgia after recovery from skin injury. In addition to the nerve block, the observation group was treated with subcutaneous ozone water at concentrations of 35 - 40 $\mu\text{g/mL}$ and doses of 10mL once a week for 4 weeks. The clinical observations showed that the cure rate in the control group was only 66.7%, compared with 90.0% in the observation group, so the advantage of ozone treatment was obvious [8] [9] [10]. A certain concentration of ozone can activate and regulate the human body's immune system, enhance the human body's immune function, and can effectively relieve the symptoms of nerve pain after herpes zoster.

Gynecological diseases have become a disease that disturbs many women, seriously affecting the normal work and life of patients. Gynecological diseases are mainly caused by pathogenic microbial interference, with high incidence and recurrence rates. If the treatment is not timely, it can cause pelvic inflammation and reproductive system diseases. In recent years, the use of various antibiotics and immunosuppressive agents has led to the increased incidence of various gynecologic diseases. Therefore, safer and more effective treatment options need to be sought. Medical ozone has an important application value in the treatment of gynecological vaginitis. The observation group added ozone treatment to the control group, which could increase the treatment effect and reduce the recurrence rate. The observation results showed that the cure rate in the observation group was 100% versus 95.0% in the control group. The recurrence rate in the observed group was 12.0%, which was significantly lower than the 23.0% in the control group [11] [12] [13] [14]. Ozone is safe and effective in the treatment of refractory recurrent vaginitis and HPV infection.

Rheumatoid arthritis (RA) is a common systemic autoimmune disease with major clinical manifestations of chronic, aggressive and symmetrical arthritis, and its pathogenesis is still unclear. In the later stages of the disease, it gradually leads to the destruction of the diseased articular cartilage and bone, eventually leading to joint deformity, and even the loss of joint function. RA can also be accompanied by cardiovascular disease, pulmonary disease and other extra-articular manifestations, which seriously reduces the quality of life and workability of patients. At present, there is no radical cure for RA. In recent years, several clinical studies have been conducted on ozone treatment of RA. The results show that medical ozone can play a therapeutic role by reducing the inflammatory response, inhibiting synovial cell proliferation and promoting its cell apoptosis in patients with RA. Ozone alone or in combination with normal medicine can effectively relieve the clinical symptoms of patients and reduce the serum inflammatory indicators. The observation group used methotrexate and clonidine combined with ozone water of 20 mL (40 µg/mL). After 5 weeks of follow-up, the effect of the combined ozone treatment was better than that of the normal treatment [15] [16] [17].

Ozone blood therapy (also known as ozone therapy) is a treatment that mixes ozone and oxygen gases with autologous blood and then sends it back into the body. Ozone therapy effectively increases the ability of red blood cells to carry oxygen, stimulate the body's nonspecific immune response, and produce multiple immunoactive factors. Ozone blood therapy is suitable for patients with ischemic disease and high uric acid to activate red blood cell metabolism and improve hemoglobin oxygen saturation; activate the immune system, multiply blood cells and enhance the ability to eliminate bacteria; activate the antioxidant enzyme system to reduce the damage of free radicals to the body. Improve blood rheology, reduce red blood cell aggregation, enhance deformation ability; improve microcirculation, reduce edema, regulate blood vessels; improve blood metabolism, reduce blood sugar, blood lipid, uric acid, improve body immunity;

improve blood vessel wall, reduce platelet aggregation, reduce blood viscosity; improve oxygen supply, promote blood circulation, enhance cell vitality, repair nerve cell [18] [19] [20].

Trauma repair is a relatively complex biological process, with multiple inflammatory cells and cytokines existing in this biological process. Ozone can promote the division of fibrotic cells, and can effectively promote wound healing, repair and rebuild the barrier function of the skin. Skin is an important barrier for the body to prevent bacteria and other microorganisms from invasion, and can effectively resist the invasion of bacteria. However, if the skin mucosa is damaged, the wound surface is infected, adversely affecting the healing of the wound. Studies have shown that in patients during trauma, inflammatory damage is dominant [21]. In the process of treating infectious wounds, it is difficult to achieve the ideal treatment effect by using conventional topical drugs, such as chemical disinfectants, antibiotics, heavy metal salts and other drugs. The proportion of patients with adverse reactions is high, and the microorganisms of the body can easily develop resistance to the drug [22]. The grade A healing rate of the patients with ozone disinfection was 83%, and the healing effect was significantly higher than that of the conventional disinfection method. Ozone disinfection is conducive to the growth of new epithelial tissue on the wound surface, and can effectively eliminate the inflammation of the wound surface to achieve the purpose of anti-inflammatory repair. In addition, ozone disinfection technology also has the advantage of quick effect, the patient's wound healing in about 4 - 5 days, and the wound healing time is significantly shorter than the conventional disinfection methods.

There are also some studies on the use of ozone in COVID-19. Related studies show that ozone molecules can be directly used in clinical, the main mechanism is the ozone molecule can directly attack the SARS-CoV-2 virus surface spike protein, not only directly destroying the spike protein structure, but also inhibiting the combination of spike protein and human lung cell angiotensin conversion enzyme 2, which can greatly reduce the SARS-CoV-2 virus infectious and pathogenic [23] [24] [25]. It reveals that ozone attacks the spiking synaptic and envelope proteins of the novel coronavirus, destroying the integrity of the virus and thus inhibiting viral infection [23]. Ozone can oxidize and inactivate the virus while stimulating the immune system in patients' cells and body fluids, which is useful in the early COVID-19 infection phase [25]. Ozone can improve gas exchange and reduce inflammation, as well as hypoxemia and multiple organ failure periods. The above evidence directly proves the good clinical application prospect of ozone in blocking the spread of the SARS-CoV-2 virus. Analysis shows that the combined drug therapy can be enhanced by intravenous injection of ozone water as an adjuvant treatment method [26] [27].

The tests of Shanghai Finerule Company show that for a patient has just caught a cold and started sneezing and shedding tears, breathing 10 - 20 ppm (vol) ozone air for a minute will heal quickly in most cases. Because novel coronavirus is highly sensitive to ozone, this method is also suitable against COVID-19.

Within 4 - 5 hours of exposure to novel coronavirus, the virus still stays on the surface layer of the respiratory mucosa, breathing 10 - 20 ppm (vol) ozone air for one minute, and gargling with ozone water, which can avoid infection [28].

The first author Gu has 20 years of experience in producing and applying ozone generators, which were previously used for environmental protection and livestock epidemic prevention. Gu always uses small ozone disinfectors for family health care and epidemic prevention, and the effect is very good. After the outbreak of COVID-19, we became to study how to use ozone in epidemic prevention and public health, and designed a household ozone disinfectant (see **Figure 1**). During the epidemic period, when all the classmates were infected, Ning insisted on using ozone disinfection every 4 - 5 hours, and has not been infected with COVID-19. Gu did many experiments and tests, and the results were very well. On a business trip in July 2023, Gu was infected with COVID-19. Only by ozone therapy, Gu was cured within 5 days, and he only suffered from pain and weakness, but he did not have a high fever, nor a loss of smell and taste. Thus, ozone can not only prevent the epidemic, but also can efficiently and quickly cure COVID-19.

There are some studies on the toxicity and side effects of ozone on human bodies. It is generally believed that medical ozone is safe and effective, and there was no report of poisoning cases for ozone treatments [29] [30] [31]. There are some statistics on the effects of environmental long-term mild ozone pollution on the inflammation of the respiratory system and ischemic heart disease [32] [33] [34]. Clinical experiments using ozone as an adjunctive therapy for COVID-19 show that ozone has no definite toxicity and side effects on patients [35] [36]. Compared with other antibiotics, ozone has less toxicity and side effects and can be better controlled. For the disinfection of the respiratory system of adults, the experiments show that ozone ensures the effective inactivation of the pathogens and does not harm the normal cells of the human body if the ozone concentration is ≤ 50 ppm (vol) and the disinfection time ≤ 60 seconds.



Figure 1. The ozone disinfectant.

3. Discussion and Conclusion

Ozone is not only a broad spectrum disinfectant, but also a green product. By properly controlling the ozone concentration and time of action, ozone has a high inactivation rate for most infectious disease viruses and bacteria, without causing side effects on the human body. Human resistance to pathogenic viruses mainly depends on the human immune system. When viruses have rates of reproduction and mutation stronger than the immune system, the disease will be difficult to cure, such as HIV. In this case, by using the powerful disinfection function of medical ozone to assist and activate the immune system, we might completely overcome the viruses. Ozone disinfection has important practical significance for the prevention and treatment of infectious diseases. In the future, more attention should be given to the powerful epidemic prevention and healthcare functions of medical ozone.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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