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**Review Article**

# Ozone ($O_3$): an excellent adjunctive tool in medical and surgical management of patient

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## ABSTRACT

In the condition like increasing susceptibility to allergic reaction & weaken response to antibiotics, along with constantly growing prices for medical treatment, new non-medicinal methods are to be appreciated. The history of medical ozone starts in the XX century. The pioneers to apply ozone in clinical practice were E. Payer, A. Fish and H. Wolf. Ozone as an antiseptic means had been known and used from the beginning of the XX century, however, extensive and systemic research in the field of ozone therapy started in Germany in mid 70s, when ozone-resistant polymer materials and convenient ozone generating equipment came into every day clinical practice. Ozone ($O_3$) therapy due to its disinfection effect & its capacity to transport & release oxygen into tissues is gaining a justified recognizing in many countries of the world. $O_3$ therapy can produce its immune modulators, anti-inflammatory, bactericidal, virucidal, fungicidal, analgesics & other effects. Considering this the purpose of this literature is to highlight the significance of Ozone as an excellent adjunctive tool in the management of various medical and surgical conditions.

**Keywords:** Ozone, $O_3$, Adjunctive medical therapy

## INTRODUCTION

In the condition like increasing susceptibility to allergic reaction & weaken response to antibiotics, along with constantly growing prices for medical treatment, new non-medicinal methods are to be appreciated. The history of medical ozone starts in the XX century. The pioneers to apply ozone in clinical practice were E. Payer, A. Fish and H. Wolf. Ozone as an antiseptic means had been known and used from the beginning of the XX century, however, extensive and systemic research in the field of ozone therapy started in Germany in mid 70s, when ozone-resistant polymer materials and convenient ozone generating equipment came into every day clinical practice. Ozone ($O_{3)}$ therapy due to its disinfection effect & its capacity to transport & release oxygen into tissues is gaining a justified recognizing in many countries of the world. $O_3$ therapy can produce its immune modulators, anti-inflammatory, bactericidal, virucidal, fungicidal, analgesics & other effects. Considering this the purpose of this literature is to highlight the significance of Ozone as an excellent adjunctive tool in the management of various medical and surgical conditions.[1]

## CLINICAL EFFECTS OF OZONE THERAPY

Ozone can produce different effect according to the chosen concentration and the way of its administration, the most important ones are:

***Bactericidal, fungicidal and virucidal*[5]**

When applied externally in a form of gaseous mixture or in ozonated solution it is recommended to use high ozone concentrations which produce direct oxidative effect on the microorganism membrane. Ozone can destroy practically all kinds of bacteria, viruses, fungi and protozoa. Gram-positive bacteria and capsular viruses having a lipid bio-layer are particularly sensitive to oxidation.[1]

***Anti-inflammatory effect*[3]**

It is revealed in ozone capacity to oxidize the compounds containing double bonds, the arachidonic acid (20:4) and its derivatives - prostaglandins, in particular. These biologically active substances participate in the development and sustaining the inflammatory process. Besides, ozone regulates metabolic reactions in tissues at the place of inflammation and resolves pH.[1]

***Ozone analgesic effect*[3]**

It is provided by oxidation of the products of albuminolysis, the so-called algopeptides. They act on the nerve endings in the damaged tissue and determine the intensity of pain response. Analgesic effect is also caused by normalization of antioxidant system.[1]

***Detoxication effect of ozone*[3]**

It is revealed in correction and activation of metabolic processes in the hepatic and renal tissues.

***Activation of oxygen-dependent processes***

Ozone doses, however low they are, cause the increase in the content of free and dissolved blood oxygen with rapid intensification of enzymes that catalyze aerobic oxidation of carbohydrates, lipids and proteins with formation of ATP energy substrate.[1,5]

***Optimization of pro- and anti-oxidant systems***

It is regarded as one of the main effects of systemic ozone therapy which is realized through its influence on cellular membranes and brining to balance the levels of lipid peroxidation products and of antioxidant defense system.[1]

***Ozone haemostatic effect*[3]**

It depends on the dose.

***Ozone immune-modulating effect***

It is based on its interaction with lipid structures of cellular membranes and depends on the chosen dose. Low ozone concentrations promote the accumulation of ozonides on the membranes of phagocytic cells - monocytes and macrophages. Due to ozonides these cells stimulate the cytokines synthesis of different classes.[1]

## METHODS OF OZONE THERAPEUTIC EFFECT

High concentrations are used for disinfection, while low concentrations promote epithelialization and healing.

***External administration includes***

The use of ozonated antiseptic salines, ozonated ointments, ozonated vegetable oil.[1]

***Parenteral methods include***

Major and minor autohemotherapy with ozonized blood, extracorporal plasma and lymph treatment, subcutaneous ozone injections, paravertebral intramuscular injections, Intravenous infusions.[1]

***Enteral method of ozone oxygen mixture***

It is recommended in gastro-intestinal pathology. It includes, intake of ozonated distillated water per os; Intestinal irrigation with ozonated distilled water, rectal insufflations with ozone oxygen mixtures.[1]

## FORMS AND METHODS TO USE OZONATED MATERIALS

***Introduction of ozone/oxygen mixture in gaseous phase*[1,2]**

This method provides analgetic, anti-inflammatory and stimulating effect.

Subcutaneous and intracutaneous 1-3ml with the concentration-10-15 mg/l.

Intramuscular injections are done with 10-20ml, concentration being 10-15 mg/l.

Intra-articular injections are done with the concentration-15 mg/l and the volume of

- 1-1.5 ml for minor joints
- 5-7 ml for middle joints
- 20 ml for major joints

***Rectal insufflations with ozone/oxygen mixture*[1]**

The procedures are done with Janet syringe or with a help of special poly-chlor-vinil tube with a patient lying on the left side with knees bent. Purgative enema is to be done two hours before the procedure. Rectal insufflations are done with ozone concentration in ozone/oxygen mixture of 10-60 mg/l, the volume ranges from 150 ml to 1000

ml, depending on the pathology, its course and stage. For newborns the volume is 20-50 ml, for children - 50-100 ml (H. Dorstewitz, 1990). Intestinal insufflations can be administered, first of all, as anti-inflammatory and disinfectant remedy to restore the bacterial flora misbalanced by pathogenic microorganisms.

The usual therapeutic dose to produce metabolic effect is 75mcg per 1kg of patient's weight, e.g. for a patient of 80kg the ozone dose is to be 75 x 80 = 6000 mcg. The course of treatment is to be started with a half-dose and minimal volume of ozone/oxygen mixture (150-200 ml) which is gradually increased to the required one.

***Vaginal insufflations with ozone/oxygen mixtures*[1]**

Vaginal insufflations are done with ozone concentration of 2-2, 5 mg/l in ozone/oxygen mixtures with the gas rate - 0, 5-1l/min for 5-10 minutes. The procedures are done with special nozzles put on the vaginal speculum.

***Minor autohemotherapy with ozone/oxygen mixtures*[1,4]**

MAHT is used to produce a stimulating effect in conditions with immune deficiency. The procedure is simple and easy to perform. Venous blood (5-10 ml) on being taken into a 20 ml syringe with 10-15 ml of ozone/oxygen mixture, ozone concentration - 10-40 mg/l, and carefully mixed, is then injected intramuscularly.

***Major autohemotherapy with ozone/oxygen mixtures*[1,4]**

For major autohemotherapy we use a flask or a special plastic bag with anticoagulant and fill it with 50-150 ml of venous blood taken from the patient. The blood upon being mixed with ozone/oxygen mixture, ozone concentration should not exceed 40mg/l (according to V. Bocci, higher ozone concentrations can lead to hemolysis) is returned to the patient via intravenous injection.

Ozone doses of 8-9mg are administered in acute stage of infectious hepatitis, which are gradually reduced to 2, 0-0, 8 mg with remittance of the exacerbation (H. Wolf, 1986). The same doses are used in herpetic infection.

## CONTRAINDICATIONS TO OZONE THERAPY[1]

1. All cases with Blood Coagulation Failure
2. Bleeding Organs
3. Thrombocytopenia
4. Ozone Allergy
5. Hemorrhagic or Apoplectic Stroke
6. Ozone Intolerance

***Note***

Ozone in low concentrations is known to produce a moderate hypo-coagulation effect, so all the drugs decreasing blood coagulation (anticoagulants, aspirin, etc.) are to be discontinued during the course of ozone therapy. In women the treatment course is to be broken up for menstrual periods.

## OZONE THERAPY IN DIFFERENT PATHOLOGIES/SURGERY

Contaminated surgery was one of the first to recognize ozone therapy and it is contaminated surgery where it has been widely used.

***General peritonitis*[1]**

***Diffuse peritonitis***

*Routes*

Ozone therapy during the operation

-Intra-operational sanitation of abdominal cavity with ozonated physiological saline

Ozone therapy in postoperative period

-Peritoneal lavage with ozonated physiological saline or programmed laparotomy

-Intravenous infusions of ozonated physiological saline

***Major autohemotherapy.*[4]**

*Management*

Ozone therapy during the operation

Ozone therapy in postoperative period

***Osteomyelitis of long tubular bones*[1]**

*Routes*

- Ozonated saline to soak the dressings (Ozonated dressings).

- Aeration with ozone/oxygen mixture in a plastic bag

- Intravenous infusions with ozonated saline

- Minor Autohemotherapy

- Major Autohemotherapy

- Intra-osseous infusions with ozonated saline.

*Management*

The treatment includes all the routes of ozone therapy enlisted above. Regarding the stage of the purulent process, ozonated dressings are to be changed once or twice every day. Plastic bags are to be put on for 20-30 minutes, ozone concentration - 5-6 mg/l. The procedures are done until the fistulas are closed and pyorrhea disappears. Intravenous infusions with ozonated saline are to be done daily within the first three days and then - every second day (up to 10-12 procedures) minor autohemotherapy is to be done every second day (up to 4-5 procedures). Intra-osseous injections of ozonated saline are to be done daily within the first three days and then - every second day (up to 10-15 procedures). Intravenous infusions with ozonated saline and minor autohemotherapy can be substituted by 6-8 procedures of major autohemotherapy done every second day.

***Atherosclerosis obliterans of peripheral vessel*[1,5,7]**

Intravenous infusions with ozonated saline

***Major autohemotherapy*[4]**

Stimulation of biological active points in the lower extremities with ozone/oxygen injections

## OZONE THERAPY IN INTERNAL DISEASES[1,2,6,7]

***Atherosclerosis and ischemic heart disease (IHD)***

Ozone has been found to produce hypolipidemic effect. After the course of ozone therapy patients with atherosclerosis had evident decrease in the levels of total cholesterin (6.4-18.4%), of lipoproteins of low density (7-28.7%), of triglycerides (10.5-17.2%) and increase of lipoproteins of high density (3.7-6.8%) levels. Ozone therapy when using small doses of ozone increases LP processes and, what is more important, it activates antioxidant defense system, thus eliminating lipoprotein toxicity, decreasing their capacity to penetrate the vessel wall, making it more resistant. Hence, ozone therapy can be regarded as an antisclerotic method of treatment. Ozone therapy proved to be effective in all IHD patients (stenocardia, cardiosclerosis, arrhythmias) at various stages of the disease from mild forms to severe ones). Its efficiency was found to be more pronounced in severe forms for it helps to control hypoxia in tissues which develops with the advance of heart insufficiency. In tissues with insufficient blood circulation the oxygen uptake by cells is done in much greater volume under ozone influence. This statement seems to be extremely important for it explains the positive effect of the method.

*Routes*

- Intravenous infusions with 200 ml of ozonated saline with ozone concentration of 20 μg/kg of patient's weight (ozone concentration at the output from the generator)

- Rectal insufflations with ozone/oxygen mixture, ozone dose being 75μg/kg of patient's weight

- Major Autohemotherapy, ozone dose being 1-3 mg.[4]

*Management*

In the course of treatment we use one of these routes. The management is done according to the patient's condition, which is evaluated on the basis of the accepted Functional Classes (FC):

- 6-8 procedures for FC-I patients;

- 8-10 procedures for FC-II patients;

- 8-10 procedures for FC-III and FC-IV patients.

The first 2 procedures of intravenous infusions or rectal insufflations are to be done every day, the rest - every second day. The procedures (6-8) of major autohemotherapy are to be done twice a week.

***Diabetes mellitus*[1,7,8]**

Ozone improves the penetration of cellular membranes for glucose. It is achieved by stimulating pentose-phosphate pathway and aerobic glycolysis that in case of DM are inhibited. It promotes hyperglycemia decrease due to better transport of glucose into tissues.

Ozone activates glucose metabolism that results in increasing content of 2, 3 diphosphoglycerate in erythrocytes which provides better oxygen supply into the tissues.

Patients with diabetes mellitus have the so called glycosylated hemoglobin forming very strong bonds with oxygen, thus, inducing hypoxia and determining the severity of the disease. That is why hypoxia control with the help of ozone therapy is of the key importance in the course of treatment.

*Routes*

- Intravenous infusions with ozonated saline

- Rectal insufflations with ozone/oxygen mixture

- Major autohemotherapy

- Minor autohemotherapy

- Subcutaneous microinjections with ozone/oxygen mixture

- Stimulation of biological active points with ozone/oxygen injections

*Management*

The basic treatment includes intravenous infusions of ozonated saline or rectal insufflations with ozone/oxygen mixtures which are done every second day (8-10 procedures). These procedures can be substituted with major autohemotherapy which is done twice a day up to 6-8 procedures for the course of treatment.

***Trauma and rheumatology***[1]

- Herniated Disc, conflicts discorradiculares
- Arthritis, rheumatic, periarthritis
- Fibromyalgia, chronic fatigue syndrome
- Multiple sclerosis, carpal tunnel
- Backache, back pain, sciatic pain
- Osteoarthritis, osteomyelitis, vertebral osteochondrosis
- Gonarthrosis, spondylarthritis, ankylosing spondylitis
- Synovitis, tendonitis, bursitis, trochanters
- Hip osteoarthritis, epicondylitis (tennis elbow)
- Pubalgia, ischial bursitis, post-surgical fibrosis, etc.

***Phlebology and angiology***[1,8]

- Venous insufficiency
- Diabetic ulcer, diabetic foot
- Decubitus sores (bed sores), varicose veins, spider veins
- Degenerative vascular diseases (arteriosclerosis obliterans)
- Lymphangitis, furunculosis, recent thrombophlebitis
- Pathologies flebiáticas, gangrene, etc.

## CONCLUSION

Medical ozone proves to be of great therapeutic potential. The procedures of its application are simple, economically preferable and beneficial. However, medical communities and practical health service still needs proper knowledge and skills to bring it into wide practice. By now, there have been accumulated quite enough experimental and clinical findings that make it possible to present the routes of ozone therapy application for effective and safe management of patients with various pathologies.

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