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APPLICATION OF INTRA-AORTIC OZONATED SALINE SOLUTION AS A METHOD OF TREATMENT OF PERITONITIS

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ABSTRACT

Currently, more and more attention is being paid to the use of local and systemic methods of ozone therapy. Ozone has a wide range of medicinal properties, including antioxidant, antihypoxant, bactericidal, anti-inflammatory, immunomodulatory, and analgesic effects. Due to these properties, ozone therapy is becoming increasingly popular in the treatment of acute surgical pathology, especially in patients with peritonitis. It is important to note that with widespread purulent peritonitis, systemic cellular hypoxia plays a key role, which leads to energy deficiency and the formation of free radicals in various organs and systems of the body. This paper presents modern data on the main mechanisms of action and biological effects of the use of medical ozone for the treatment of widespread peritonitis. Specific methods of ozone therapy and their effectiveness, confirmed both by experimental studies on animals and by the results of clinical practice, are considered. Ozone therapy is a promising method in the complex treatment of patients with widespread peritonitis. Its use can reduce inflammation, improve tissue oxygenation, activate metabolic processes, and restore energy balance in the body. This opens up new opportunities for effective treatment and rehabilitation of patients with peritonitis.

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Introduction

Even though the methods of surgical treatment and intensive care are constantly being improved, and the latest technologies and medicines are being introduced into clinical practice, peritonitis remains one of the most common and dangerous complications in abdominal surgery. Mortality with widespread peritonitis averages 20-30%, and in the most severe cases it can reach 50-70%, and in recent decades there has been no significant decrease in this statistic [1]. In this regard, the problem of developing and implementing new approaches to improving the results of the treatment of peritonitis remains urgent. One

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of the promising approaches in this direction is the use of ozone therapy both locally and systemically. Ozone has a wide range of medicinal properties **(Figure 1)** [2].

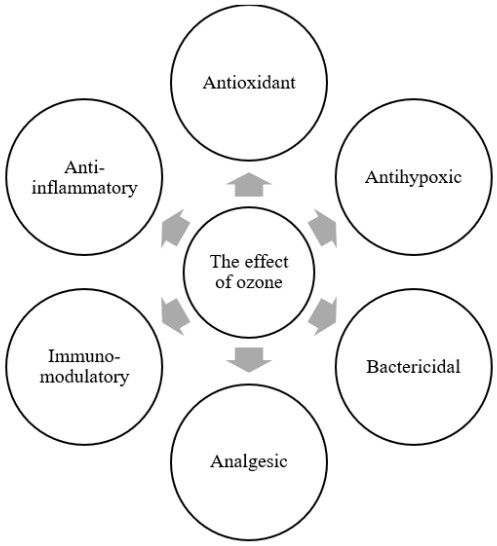

Figure 1. Pharmacological effects of ozone

Due to these properties, ozone therapy is increasingly used in the treatment of acute surgical pathology, including patients with peritonitis. It is known that systemic cellular hypoxia plays a key role in metabolic changes in the body with widespread purulent peritonitis. It leads to the development of energy deficiency and the formation of free radicals in the tissues of various organs and systems [3]. Free radicals cause damage to cell membranes and, spreading through the circulatory system, harm vital organs and systems, which ultimately leads to their functional insufficiency. The use of ozone therapy can help to cope with these problems. Ozone, having antioxidant properties, can reduce the level of free radicals and prevent cell damage. It also improves blood circulation and oxygen supply of tissues, which contributes to the restoration of their functions [4]. Improvement of the oxygen transport function of blood, its rheological properties, and activation of bioenergetic processes accompany the antihypoxic effect of ozone by increasing the concentration of oxygen in plasma. As a result of the oxidative destruction of phospholipids of erythrocyte membranes, their deformability and resistance increase, which increases the partial pressure of oxygen in the blood and improves microcirculation. The number of destructively altered shaped blood elements decreases. It is also important to intensify the processes of glucose utilization by erythrocytes. As a result of the interaction of ozone with blood cells, a pH shift to the acidic side is observed [5]. This is explained by the interaction of ozone with the carbonate buffer, the change in the ionic composition of the shaped elements of the blood, as well as the reaction of ozone with the protein buffer. It is also accompanied by a decrease in the rate of erythrocyte sedimentation, a decrease in leukocytosis, and intoxication by the leukocyte index.
Thus, the use of ozone therapy in the treatment of peritonitis is a promising approach that can help improve treatment outcomes and reduce mortality from this complication. Further research and clinical trials will help to fully unlock the potential of ozone therapy in this area and determine the optimal protocols for its use.

Materials and Methods

A search was conducted for scientific articles in various scientometric databases using the keywords "ozone", "peritonitis", "ozonated saline solution", and "ozone therapy". Such resources as PubMed, CyberLeninka, Hindawi, and Google Scholar were used as sources of information, while access to the materials of interest was not limited. In addition, a manual literature search was also conducted.

Results and Discussion

Optimization of peripheral blood circulation helps to reduce the tone of arterioles and the opening of non-functioning capillaries, which leads to an improvement in the work of compensatory collateral anastomoses. This process, together with the ozone-oxygen mixture, contributes to the establishment of a normal oxygen supply of ischemic tissues. Due to this, there is an improvement in energy metabolism and an increase in synthesis processes in the focus of inflammation [6]. An increase in the oxidative potential of the blood caused by the action of ozone stimulates metabolic processes in the liver. This is manifested in the improvement of the detoxification function of the liver, catabolism of steroid hormones, and changes in insulin sensitivity. In the case of hypoxic conditions, ozone also has a protective effect, reducing the degree of dystrophic

changes in hepatocytes and maintaining normal levels of glucose, glucose-6-phosphate, pyruvate, and glycogen in the liver. Glycogen also has antioxidant properties due to the glucuronic acid formed from it [7]. Ozone also contributes to an increase in the number of unchanged mitochondria, maintaining the normal structure of the endoplasmic reticulum, and increasing the number of lysosomes and glycogen granules. The use of ozone stimulates the mechanisms of conversion of fatty energy substances into carbohydrates, which reduces the likelihood of developing fatty degeneration and the formation of toxic ketone products from fatty acids. An important detoxification reaction in the liver is the oxidative reaction of toxins involving cytochrome P-450, which is part of the redox enzyme chain. Biochemical studies show that the systemic use of medical ozone increases the content of cytochrome P-450 in the liver [8]. Thus, ozone therapy activates intracellular mechanisms of plastic, glycolytic and antioxidant functions of hepatocytes. The relationship between these mechanisms underlies the improvement of liver function in many aspects, including antitoxic function **(Figure 2)**.

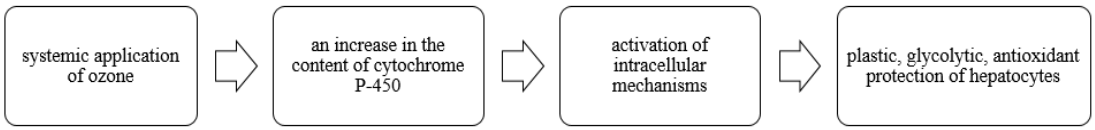

Figure 2. Detoxification function of ozone

Literature data confirm the immunomodulatory effect of medical ozone [9]. In particular, under the influence of ozone therapy methods, the process of phagocytosis is activated, which largely depends on the concentration of oxygen in the peripheral blood and oxygen access to the wound. It largely depends on the concentration of oxygen in the peripheral blood and oxygen access to the wound. In wounds that do not heal for a long time, the cellular composition of the inflammatory infiltrate changes morphologically [10].

The cellular composition of the inflammatory infiltrate changes and regenerative processes prevail over the processes of decay. The antimicrobial effect of ozone is achieved through direct oxidative action. Local activity against microorganisms is associated with the destruction of the shell due to the oxidation of microorganisms. Oxidation of phospholipids and lipoproteins and damage to polypeptide chains [11]. Low doses of ozone cause local damage to the membrane and stop the division of bacterial cells. High doses damage many enzymes, transport, and receptor systems that ensure the vital activity of the bacterial cell, causing respiratory disorders and increased permeability of the cytoplasmic membrane, which leads to cell death. According to the literature, medical ozone can inactivate microorganisms with drug resistance factors. Ozone can inactivate microorganisms with drug resistance factors. It has been described that ozone at a concentration of 4 mg/l completely suppresses the growth of Staphylococcus aureus, Escherichia coli, Proteus, and Klebsiella up to 104 CFU/g of tissue [12]. As the degree of tissue contamination increases, the inactivation of microorganisms becomes incomplete, while sensitivity to antibiotics increases.

In experimental peritonitis, the local use of ozone reduces the intensity of spike formation [13]. Thus, ozone therapy has a positive effect on the main etiological and pathological relationships of a wide range of peritonitis. The general clinical approach to local ozone therapy for peritonitis is as follows. Ozone therapy for peritonitis consists of intraoperative disinfection of the abdominal cavity and postoperative peritoneal lavage, a method of disinfection of the intestinal wall cavity, and intravenous administration of ozonated distilled water. In intraoperative peritoneal lavage, after eliminating the cause of peritonitis, the peritoneal cavity is thoroughly cleaned with 4-5 liters of physiological ozone solution at a concentration of 4-5 mg/l [13]. Postoperative cleansing of the peritoneum is performed by injecting ozonated sodium chloride with an ozone concentration of 4 mg/l into the peritoneal cavity through a drainage tube [11]. An effective enteral method of ozone therapy in the combined treatment of acute diffuse peritonitis is the method of disinfection of the intestinal cavity wall. A special probe with a spirally fixed hollow tube with a slit valve for drug delivery has been developed for this method. Experimental results and clinical testing of this method have proved that it has the greatest effectiveness in combination with abdominal hygiene. Thus, the improvement of the endogenous toxic syndrome and elimination of intestinal paresis in patients with early diffuse peritonitis has been achieved. Against the background of the elimination of intestinal paralysis, the frequency of infectious complications decreased, and mortality decreased by 9.5% [12]. Local ozone therapy of diffuse peritonitis was effective in combination with the use of ozonated physiological solutions and ozone-oxygen mixtures. The efficiency of the experimental application of ozonated perfluorane in combination with ozone-oxygen mixtures is investigated. The results showed that ozonated perfluorane has a more pronounced protective effect against non-specific factors of peritonitis.

Conclusion

Thus, the versatility of the pathophysiological effects of medical ozone in combination with various systemic and local methods of its application indicates the effectiveness of its use and the prospects for further development in the complex intensive treatment of diffuse peritonitis. The use of ozonated saline solution can prevent the development of severe liver failure and improve long-term survival. We believe that ozone therapy is a promising method in the complex therapy of patients with widespread peritonitis. The use of ozone therapy helps to reduce inflammation, improve tissue oxygenation, activate

metabolic processes, and restore energy balance in the body, which opens up new opportunities for effective treatment and rehabilitation.

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