Ozone Vs Ozone Therapy: The Paradox

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OZONE

Ozone is recognized as a very powerful oxidizing agent (1,2) capable of polluting the environment and producing adverse effects when inhaled by humans (3). It has been established that short periods of ozone exposure through the airways, produces reactions that include: reduction in ventilatory function; increased permeability and reactivity of the respiratory tree; an increase of the endogenous mediators and inflammatory cells, and a decrease of neumocytes Type 1, in the alveoli (4,5,6). Bronchoalveolar lavage fluids from humans exposed to ozone exhibit increased neutrophil infiltration and increased content of inflammatory mediators and cytokines (1). Some investigators correlate the neutrophil infiltration with high levels of interleukin 8 (IL-8) that are found in these fluids (3). Also, it has been reported that the damage that ozone causes, when inhaled, is directly related to the release of Araquidonic acid of the cellular membrane of the lungs, producing an increase in Leukotrienes levels, the first responsible for the chemotaxis process. As a result, neutrophils are attracted toward the pulmonary tissue causing local damage (6).

In animals that inhaled ozone for hours or days, alterations in the biochemistry and the pulmonary morphology were observed, as was a potential for bacterial respiratory infection. The morphological changes were seen in the terminal bronchus and in the alveoli, accompanied by damage to the ciliated cells and the alveolar epithelium Type I. These structures are replaced, later, by a proliferation of Clara-cells and epithelial cells Type II, respectively (2). It has been reported that the presence of tumoral nodes (adenomes) on the pleural surface in animals exposed to ozone through the airways, showed a significant statistical difference from the control group (not exposed to ozone). Other cellular alterations include hyperplasia and metaplasia, especially those which can be considered as inflammatory reactions (2). In this sense it is reported that animals, exposed to ozone by inhalation, show a dose dependent effect, generating inflammation in the centriacinar region of the lung with ulterior fibrosis at that level (7). It is also reported that ozone exposition promotes or causes DNA damage (8).

While considering all these aspects, much is still unknown about ozone and its harmful effects. Research has produced differential and sometimes paradoxical results. For example, it has been seen that ozone inhalation did not produce carcinogenic effects nor did it increase the incidence of pulmonary neoplasia in rats of both sexes (7). Schulz et al. report anticarcinogenic effects in NMRI mice treated with urethane and ozone (9).

A phenomenon has also been reported of tolerance to ozone in experimental animals that have inhaled a low dose, during long periods of time. This effect has been related to an increase in the antioxidant enzyme level, namely glutathione S-transferase, glutathione peroxidase, catalase and superoxide dismutase (10,11). Other studies have found a decrease in the damage done to the pulmonary tract in rats which were exposed previously to low doses of the gas for seven days followed by high ozone concentrations. This suggests that initially low doses may reduce the permeability of the lower airways and causes them to face out thus providing protection later when greater ozone concentrations are administered (12).

These discrepancies in ozone research data, the well-know adverse effects when ozone is inhaled, as well as the paradoxical effects found after the utilization of the gas, give us some reasons for reflection.

From the epidemiological point of view, it is seen that only some projects have been used to study

the effects of ozone exposure by airways and that more studies are needed to evaluate and distinguish between acute and passing effects of ozone. Also, further research is needed to determine the extended effects of this gas on premature pulmonary aging, and on the symptomatology and the mortality of human beings. Future studies should investigate a wider range of variables in the effort to obtain a more comprehensive interpretation of the phenomenon described above (13).

OZONE THERAPY

Ozone employed for medical purposes is a gas constituted by an ozone/oxygen mixture it is obtained by means of an electrical discharge through pure oxygen, achieving concentrations between 0,05 and 5 in percent of volumes. Chemically it is a triatomic molecule and an allotropic form of oxygen (14). After the discovery of ozone, by Christian Friedrich Sch□nbein in 1840, many decades passed without any interest in its uses in medicine. It was not until the beginning of World War I when Albert Wolf used the gas for the first time for therapeutic purposes, in particular for the healing of infected wounds. Wolf also employed ozone, using its deodorant property, in patients with rectal and gynecological cancer (15). Thereafter, the lack of plastic materials for the application of the gas, the discovery of new antibiotic drugs (namely sulphonamides and penicillins), and a certain skepticism that always has been associated with the applications of ozone in the field of medicine have impeded development of medical applications (16). Dr. Joachim H□nsler from Germany, in the late 1950s, invented and designed the first therapeutic ozonizer with the use of plastic materials. This opened new perspectives for the application and extension of ozone therapy (16). Unfortunately, the scarce studies of the biological bases of ozone therapy and the clinical experience, although vast, have been limited to private practice and have produced in mainly anecdotal material which was not published in peer-reviewed journals. Moreover the general knowledge that ozone is a serious pollutant that can generate oxidizing compounds has comprehensibly prejudiced the public against its use (17).
BIOLOGICAL ACTIONS AND THERAPEUTIC PROPERTIES OF OZONE

As ozone is an extremely reactive and unstable gas, it has been postulated that the mechanisms through which it acts are directly related to the products that it generates (18) through selective interaction with organic compounds that are present in the plasma and in the cellular membranes. For this selectivity, the reaction of ozone with lipids occurs in the carbon-carbon double bond which is present in polyunsaturated fatty acids, thereby generating organic peroxides and ozonides (19). All these products, in a controlled and appropriate quantity, can exert different biological actions, namely those which confer on ozone a series of therapeutic properties (20-26). These are shown in Fig.1.

Figure 1. Biological actions of ozone

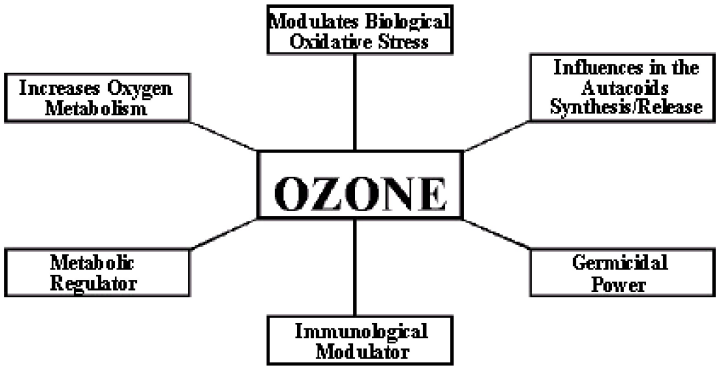

Figure 1. Biological actions of ozone

These biological effects produce beneficial results when ozone is applied therapeutically in appropriate doses without producing any adverse reactions (27), especially genotoxic damage (28). The wide range of effects thus generated make possible its application in a diversity of medical specialties, and within these, different pathological processes.

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