The Effect of Ozone on the Lipid Peroxidation Processes in Case of Mandible Fractures.

N.E. Homutinnikova¹, E.A. Durnovo²

¹²Nizhny Novgorod State Medical Academy, Department of Surgical Dentistry and Maxillofacial Surgery, Minin sg. 10/1, 603005, Nizhny Novgorod, RUSSIA.

Abstract

For optimizing osteogenesis and preventing development of posttraumatic inflammatory complications of open fractures of mandible we have included ozonetherapy in the medical treatment complex. Ozone was administered in 0,9% NaCl solution intravenousy and locally as ozonized water. We have performed the comparative analysis of lipid peroxidation indexes and antioxidant activity of blood serum and oral fluid in patients with open fractures of mandible who received conventional treatment and ozone therapy.

The recommended therapy method let us perfect the conventional conservative treatment of open mandibular fractures and prevent the development of posttraumatic inflammatory complications.

Introduction

The treatment and prophylactics of inflammatory complications of open fractures of mandible is an actual problem in maxillofacial traumatology. Up to 40% of patients suffer from inflammatory complications developed after fractures due to their late visits to an in-patient department. At present, the following number of factors is found to effect on healing processes of mandible fractures in an unfavourable way: regional circulation impairment, inflammatory processes and tissue hypoxia at the site of fracture, oral local immunity inhibition. The localization of a fracture line within denture limits leads to the infection caused by pathogenic microflora of an oral cavity [1]. It results in the changes in normal free radical processes on cell membranes. The changes in local defense factors and intensity of lipid peroxidation (LP) processes as well as in antioxidant activity (AOA) of oral fluid are also noticed. Thus, the study of aforementioned indexes is of great interest as for a prognosis of inflammatory complications, developed in the early posttraumatic period in case of mandible fractures.

Ozone therapy was applied in the complex treatment to optimize osteogenesis and to prevent inflammatory complications of open fractures of mandible. Ozone is widely applied in medicine due to the wide spectrum of its biological effects. Among them we should mark its analgetic, antiinflammatory, antimicrobial, trophic and immunomodulative effects. The experimental and clinical trials demonstrated that application of ozone at concentration, established by us, produces a positive effect on the level of oxidation-reduction processes in blood, including the increase in its antioxidant potential [2,3].
The purpose of the given research is to determine the efficiency ozone therapy in the complex treatment of open fractures of mandible and in prophylactics of postrauumatic inflammatory complications, the effect was evaluated by indexes that characterize LP and AOA of blood serum and oral fluid.

**Materials and Methods.**

We treated 60 patients at the age from 18 to 60 years with open fractures of mandibular body and angle. The groups comprised 52 males (86,6%) and 8 females (13,4%). The mean age was 36 years. The majority of patients were admitted to hospital on the 3-4th day of disease with the signs of inflammation at the site of fracture. Before their admission the patients did not receive any antibacterial therapy.

According to the method of treatment the patients were divided into 2 groups:
The first test group (32 people) - the patients received complex conservative treatment of mandibular fractures plus ozone therapy without antibacterial therapy.
The second control group (28 people) - the patients received complex conservative conventional therapy of a mandibular fracture.

The mode of ozone therapy of open fractures of mandible was as follows: on admission we performed the primary surgery of a fracture line after pretreatment of osteal wound with ozonized distilled water, then followed reposition and immobilization of the fractured parts with bimaxillary Tigershted's splints. Ozonized 0,9% NaCl solution at 102 - 196 mcg/l ozone concentration was administered intravenously and ozonized distilled water was administered locally at 273 mcg/l ozone concentration. Ozone concentration was established in accordance with the elaborated method. The course of treatment lasted 10 days. For ozone therapy we used a device AOT-H-01 (manufactured in Russia).

The control over the ozone therapy safety and efficiency was based on the analysis of LP processes and AOA of blood serum before and after a course of treatment. Lipid peroxidation processes state was evaluated by parameters of chemoluminescence intensity with the use of a device БХЛ - 06 and by the level of lipid peroxidation molecular products: primary - diene (DC) and triene (TC) conjugates by Shenstone's method [4] and final products - Shiff's basis (SB) by Fletcher's method [5]. The total AOA of blood serum and oral fluid was calculated according to the chemoluminescence data with the use of a device БХЛ - 06. We used the method of Kusmina E.I. and associates [6].

The statistic data processing was carried out by “Microsoft Excel” Computer Program. When carrying out the data processing due to the enormous variability of initial values and to the dependence of the given indexes on a number of factors we have investigated the dynamics of presented indexes in case of administration of different methods of treatment in patients with open fractures of mandible. We considered all initial data (on admission) to be 100% then we determined the character and reliability of final products changes in each patient (after treatment) in comparison with the initial level.
Results and Measurements

On the basis of the received data we have marked that in all patients with mandible fractures before treatment there was activation of LP processes, that being the result of disturbances caused by acute mandible trauma as well as by inflammatory changes occurring in mandible fracture. During the course of ozone therapy we have noticed the tendency towards decreasing in the DC and TC, SB levels, while in patients who received conventional treatment, on the contrary we have recorded some rise in concentration of these indexes. These products make a cell membrane permeable and activate intracellular metabolism. However, due to unstability of these compounds one can not judge about the efficiency of the method only by the given data. The most informative criterion is the recording of final products of lipid peroxidation - SB, which determine final membrane rigidity. The decrease in these indexes testifies to the restoration of cell membrane structure. The changes in LP and AOA indexes of blood serum after treatment in patients with open fractures of mandible (depending on the method of treatment) are presented in Table I.

Table I.

The changes in LP and AOA indexes of blood serum in patients with open fractures of mandible after treatment (%).

<table>
<thead>
<tr>
<th>Groups of patients</th>
<th>Initial Data (%</th>
<th>SB (%</th>
<th>I max (%</th>
<th>AOA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Test group (patients received ozone therapy) n = 32</td>
<td>100</td>
<td>70,2 %*</td>
<td>118,2 %*</td>
<td>135,4 %*</td>
</tr>
<tr>
<td>2. Control group (patients received conventional treatment) n = 28</td>
<td>100</td>
<td>95,3 %*</td>
<td>110,1 %*</td>
<td>102,3 %*</td>
</tr>
</tbody>
</table>

* the differences in values after treatment from values before treatment are reliable \( p \leq 0,01 \).

The given data testify to the fact, that in the group of ozone treated patients SB level decreased by 28,8 % \( (p = 0,01) \) against the background of the reliable increase in total AOA by 35,4 % \( (p = 0,01) \). In patients who received conventional therapy there were no any sufficient changes in lipid peroxidation indexes: DC and TC, SB. Antioxidant activity of blood serum did not change.

Discussion.

The inhibition of LP processes during the course of ozone therapy with ozone at low concentration has been connected with the activation of oxygen dependant intramembrane enzymatic antioxidants. The high reactive property of ozone induces the trigger of antioxidant defense mechanism, that preventing the cell destruction. In the course of treatment in both
groups Imax level was increasing in patients who received ozone therapy by 18,2 %, while in patients who were treated conventionally by 10,1 %. In case of medical ozone application the activation of lipid peroxidation (I max) is connected with the destabilization of antioxidant defense system in patients with occurring inflammation. The rise in free radical concentration initiated by ozone administration gives the possibility to fulfill “peroxidation burst”, that being the basis for ozone antimicrobial effect [7]. Ozone therapy of mandible fractures makes it possible to produce powerful antiinflammatory effect without administration of antibacterial drugs. The involvement of ozone at low concentrations permits to regulate this process because it activates antioxidant defense system to a degree enough to prevent desorganization of prooxidant - antioxidant system [8]. In case of conventional therapy there occurs reserve activation of antioxidant defense system. However, the administered antibacterial treatment does not permit to keep this activity on a high level. The breakdown of antioxidant system reserve, the lack of initiation to the synthesis of natural antioxidants lead to the activation of LP.

It is reasonable to study the parameters of oral fluid due to the fact that the character of processes in oral fluid greatly influences on the course of treatment. On admission the patients had initial inflammatory changes in fractured area due to the absence of immobilization of fractured parts before hospitalization and to the poor oral hygiene. The dynamics of LP and AOA indexes of oral fluid in patients with open fractures of mandible after treatment are presented in Table II. (depending on the therapy method).

<table>
<thead>
<tr>
<th>Groups of patients</th>
<th>Initial Data (%)</th>
<th>DC (%)</th>
<th>TC (%)</th>
<th>SB (%)</th>
<th>I max (%)</th>
<th>AOA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Test group (patients received ozone therapy) n = 32</td>
<td>100 %</td>
<td>120,3 %</td>
<td>109,2 %</td>
<td>79,1 %*</td>
<td>135 %*</td>
<td>174,6 %*</td>
</tr>
<tr>
<td>2. Control group (patients received conventional treatment) n = 28</td>
<td>100 %</td>
<td>87,39 %</td>
<td>91,16 %</td>
<td>96,5 %*</td>
<td>123,3 %*</td>
<td>84,9 %*</td>
</tr>
</tbody>
</table>

* the differences in values after treatment from values before treatment are reliable p ≤ 0,01.

After treatment in the test group there was marked increase of DC levels by 20,03 %, TC by 9,23 %, and SB decreased by 20,86 %. In case of ozone application the pronounced increase of I max by 35%, total AOA by 74,6% (p = 0,01) was noticed, that probably depending on stimulation of oxygen dependent membrane processes by ozone. Therefore, processing of oral cavity with ozonized water on account of slight increase of LP primary products produces compensatory activation of antioxidant defense chain, it being the important component of pathogenetic treatment of the given patients.
In control group after treatment there was slight decrease of DC levels by 12.6 %, TC by 8.84 %, SB by 3.48 %, increase in I max by 23.2 %, but the antioxidant system activation was not marked.

Exhaustion or breakdown of antioxidant defense system, it being noticed during the course of conventional therapy, leads to uncontrolled free radical oxidation, that resulting in possible development of inflammatory complications of open fractures of mandible. The early stabilization of LP processes along with increase in antioxidant defense system efficiency is the most effective pathogenetic component of complex conservative therapy of patients with open fractures of mandible.

**Conclusion.**

Thus, on the basis of the received data we can make the conclusion that the recommended ozone therapy method let us perfect the conventional methods of conservative therapy of open fractures of mandible and prevent the development of inflammatory complications by stabilization of membrane LP processes in the body as well as in oral cavity.

**References.**

2. Масленников О.В., Конторщикова К.Н. Озонотерапия. Внутренние болезни. Методическое пособие (Н.Новгород, Россия, издательство НГМА,1999), с.7-9, ISBN 5-7032-0317-1.
3. Дурново Е.А. “Обоснование использования озона в комплексном лечении флегмон лица и шеи. Автореф. дис... канд. мед. наук (Н.Новгород, Россия, 1998), с. 29-37, 140 -144.