The Use of Ozone in Medicine

Mechanisms of Action

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Ozone Treatment in Surgery

- 1915 A. Wolff
- 1935 E. Payr
- 1937 P. Aubourg
- 1977 O. Rokitansky
- 1981 H. Werkmeister,
- 1987 H.G. Knoch,
- 2002 Calderon, N.A. Kauffmann, T
Mechanism of Action in Topical Applications

1. Microbicidal effects
   ie bactericidal, fungicidal, virustatic

2. Wound cleansing effect

3. Wound healing effect
Mechanisms of Action of Ozone in Systemic Applications

1. Activation of Red Blood Cell Metabolism
2. Activation of Immunocompetent Cells
3. Activation and Induction of Biological Antioxydants and Radical Scavengers
## Indications of Ozonetherapy Today and the Pharmacological Background

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Pharmacological Effects 1: Red Blood Cells

- 1975 Buckley et al.
- 1979 Freeman, Miller et al.
- 2001 Lell, Viebahn et al.
- 2002 Hoffmann, Viebahn

- Peroxide formation and activation of the RBC-metabolism via the glutathion system with improvement of oxygen release
Mechanisms of Ozone Reactions

a. structure of the ozone-molecule

b. mechanisms of ozone-reactions

c. „ozone-peroxides“
The Action of Ozone on the Red Blood Cell Metabolism
2,3-DPG (in %) in vivo:
Arterial Circulatory Disorders, stage III +IV. (Rokitansky et al. 1981)
Mechanism of Action 1
Activation of Red Blood Cell Metabolism

- Increase in ATP and 2,3-DPG
- Shift of HbO$_2$/Hb-balance to the right and
- Improvement of oxygen-release
2,3-DPG in Blood Preserves in mg/L Serum (N = 5)
ATP and 2,3-DPG in % as Measure for Activation of Cell Metabolism in Elderlies
Pharmacological Effects 2: immunocompetent cells

- 1990-2002 Bocci et al.

- Induction of cytokins such as interferons, interleukins and growth factors

Cytokin induction in % dep.on O₃-conc.
Pharmacological Effects 3: Radical Scavengers

- 1998 León et al.
- 1999 Peralta et al.

- Activation of antioxidative enzymes and radical scavengers as protective effect in damage by free radicals.
The Action of Ozone on the Red Blood Cell Metabolism

\[ \text{Glucose} \rightarrow \text{Glucose-6-Phosphat} \rightarrow \text{NADP} \rightarrow \text{NADPH} \rightarrow \text{GSH} \rightarrow \text{GSSG} \rightarrow \text{ROH} \rightarrow \text{R-O-O-R} \]

\[ \text{1,3 DPG} \rightarrow \text{2,3 DPG} \]

\[ \text{K}^+ \rightarrow \text{Na}^+ \rightarrow \text{ADP} \rightarrow \text{ATP} \rightarrow \text{Lactate} \rightarrow \text{HbO}_2 \rightarrow \text{Hb} + \text{O}_2 \]
Hepatic Ischemia/Reperfusion Damage
(Peralta et al 1999)

$H_2O_2$ (µmol/g); SOD (u/mg Protein); GSH (nmol/mg Protein)
OZONE and Prevention (León et al. 2002)

Histological results correspond completely to biochemical measurements.


a) Control

b) CCl$_4$-induced Glycogen-Depletion

c) 15 preventive Ozone Application
Protection Against Hepatic Cellular Damage induced by Carbontetrachloride in an Animal Model through 10 rectal Insufflations before CCl$_4$—Application. (León et al. 1998)
Reperfusion Damage in Renal Cells (Calunga et al. 2001)

Control

Isch/Reperf.

$O_2 + I/R$

$O_3 + I/R$

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Reperfusion Damage in Kidneys in an Animal Model following rectal ozone application compared to pure oxygen.

Histological results: % without lesion, N=10/group. (Calunga et al. 2002)
Mechanism of Action 3
Enzymatic Antioxydants and Radical Scavengers

- such as SOD, GSH-peroxidase and GSH - reductase ...
- are induced and activated by Ozone-formed peroxides,
- thus increasing the organism`s antioxydative capacity.
Pharmacological Effects 4: Ozone and Prevention

- 1999 Schulz et al.
  - Improvement of survival rate in septic peritonitis in an animal model by pretreatment with ozone.
  - Synergistic effect with antibiotics.

- 2001 Lell, Viebahn et al.
  - Growth inhibitory effect of plasmodium in infected RBC’s by pretreatment with ozone.
Peritonitis Model in Rats. Survival Rate with Ozone in % (Schulz et al. 1999)
Peritonitis Model in Rats. Survival Rate in %

a. Ring Shaped Plasmodia and Mature Schizonts
b. Female Plasmodia falciparum Gametes
(acc. Lieske et al. 1991)
Plasmodium falciparum infected Red Blood Cells + Ozone. Parasitemia in % (Lell, Viebahn, Kremsner 2001)
P. falciparum infected Red Blood Cells + Ozone: pre and post infection. Parasitemia in %
Ozone and Prevention
Indications, Applications and Dosages

- Herpes (post Zoster Neuralgia)
- Susceptibility to Infections
- General Immunoactivation and Revitalization
- Presurgical measure
- Preventive Application in Chemotherapie and Radiation
- Allergies

Major Autohemotherapy
with 800 to 2000µg Ozone per treatment (50 ml with 16-40 µg/ml)

Rectal Insufflation with 10-20µg/ml and a Volume of 150-300 ml, in children 30-50 ml

Minor Autohemotherapy
with 220 µg Ozone in 3-5 ml Patient’s Own Blood