

The use of ozone in complex therapy of burn disease

Peretyagin S.P., Vorobyov A.V., Struchkov A.A., Kostina O.V., Bitkina O.A., Gordinskaya N.A., Kvitcinskaya N.A.

***Research Institute of Traumatology and Orthopaedics
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We single out
four periods
in burn disease:

The periods of burn disease

- Burn shock

Acute burn toxemia

Septic toxic period

Period of recovery









Complications of burn disease

- 1. Early complications, directly associated with features of trauma and the course of acute period of burn; these complications normally develop within the first week after trauma and they are as follows: a) the diseases of unfulfilled adaptation (early dysfunction of homeostasis) which manifest themselves as metabolic exhaustion, polyorgan failure, early burn sepsis; b) the lesions of organs which are not included in the system of homeostasis; c) primary pathology of lungs and upper airways (as a result of thermal inhalation trauma).*
- 2. Late complications which develop after the 2 or 3 week after trauma are as follows: a) burn exhaustion; b) the diseases of disadaptation (late dysfunction of homeostasis system) metabolic exhaustion; polyorgan failure; late burn sepsis; b) the lesions of organs which are not included in the system of homeostasis, including among them local purulent complications.*

3. Intramoxic complications

Ozone may be used
in complex therapy of burn
disease
in the following situations:

The components of combined treatment in high technological treatment of burn disease patients

- Active surgical tactic
 - Early necrectomy
 - Accelerated processing of the wounds to skin grafting ← 
 - Autodermografting
 - Early reconstructive-plastic operations ← 
 - Application of modern wound covers ← 
 - Transplantation of cultivated skin cells
- Intensive infusion therapy ← 
- Efferent therapy ← 
- Therapeutic and diagnostic fibro-bronhcoscopy and fibro-gastroduodenoscopy ← 
- Enteral and nutritional support
- Multicomponent therapy with medications ← 
- Surgical and conservative methods of treatment of burn sequelae ← 

- Taking into account the pathogenesis of development of injuries in burn trauma, the general purpose of ozonotherapy is reactivation of oxygen homeostasis

Severe burn. Thermal necrosis of the tissues

The lose of plasma, water and energy. Perversion of cell metabolism. The appearance of toxic products in circulation. Thermal and toxic hemolysis of erythrocytes

Depression of heart function. Reduction of heart outflow.

Hemoconcentration.

Decrease of venous inflow.

Increase of blood viscosity

Arterial hypotension

Release of catecholamines

Peripheral vasoconstriction

Decrease of capillary circulation

Sludge.

Output of fluids in tissues.

Peripheral vasodilatation

Disseminated intravascular coagulation (DIC).

Metabolic acidosis.

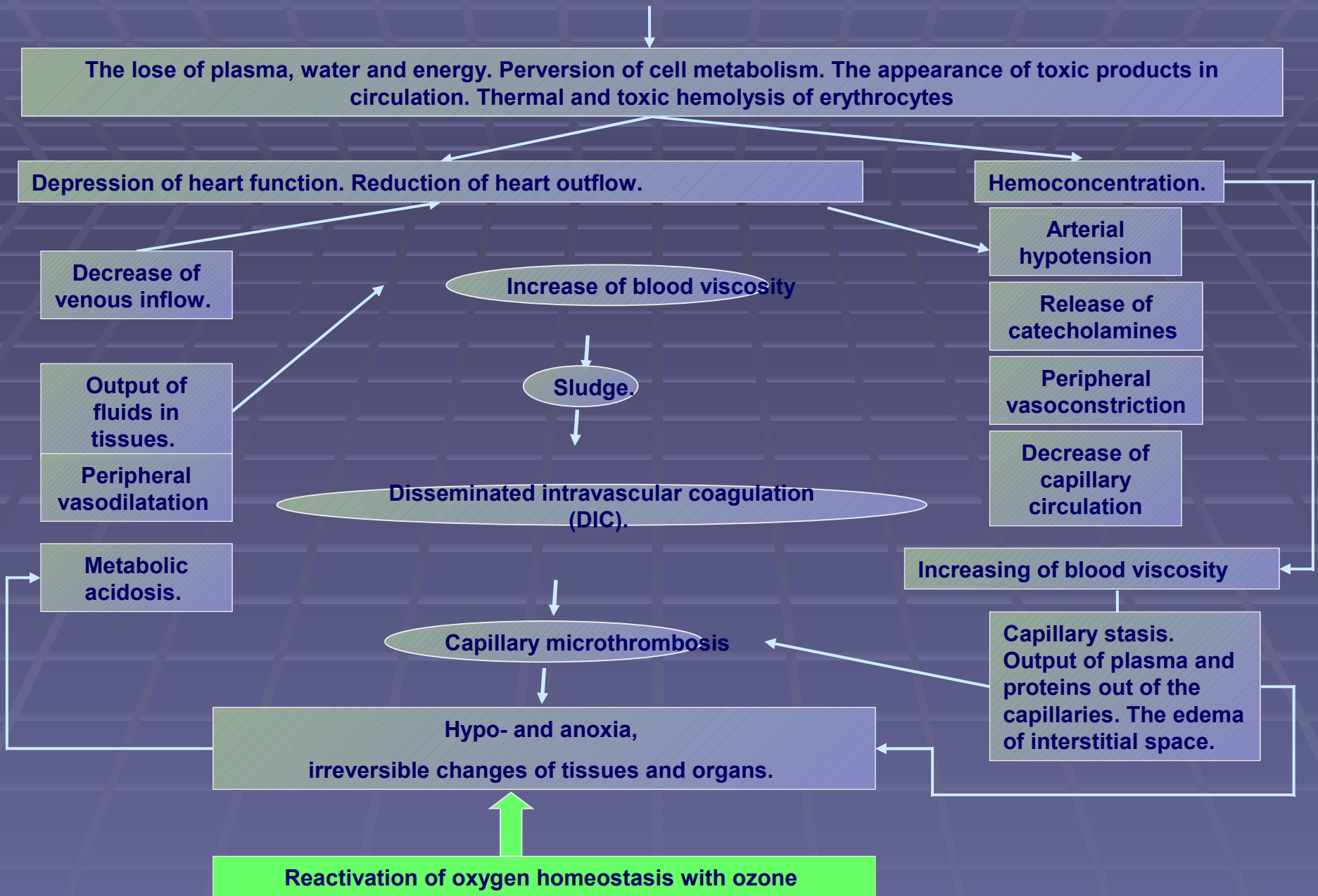
Increasing of blood viscosity

Capillary microthrombosis

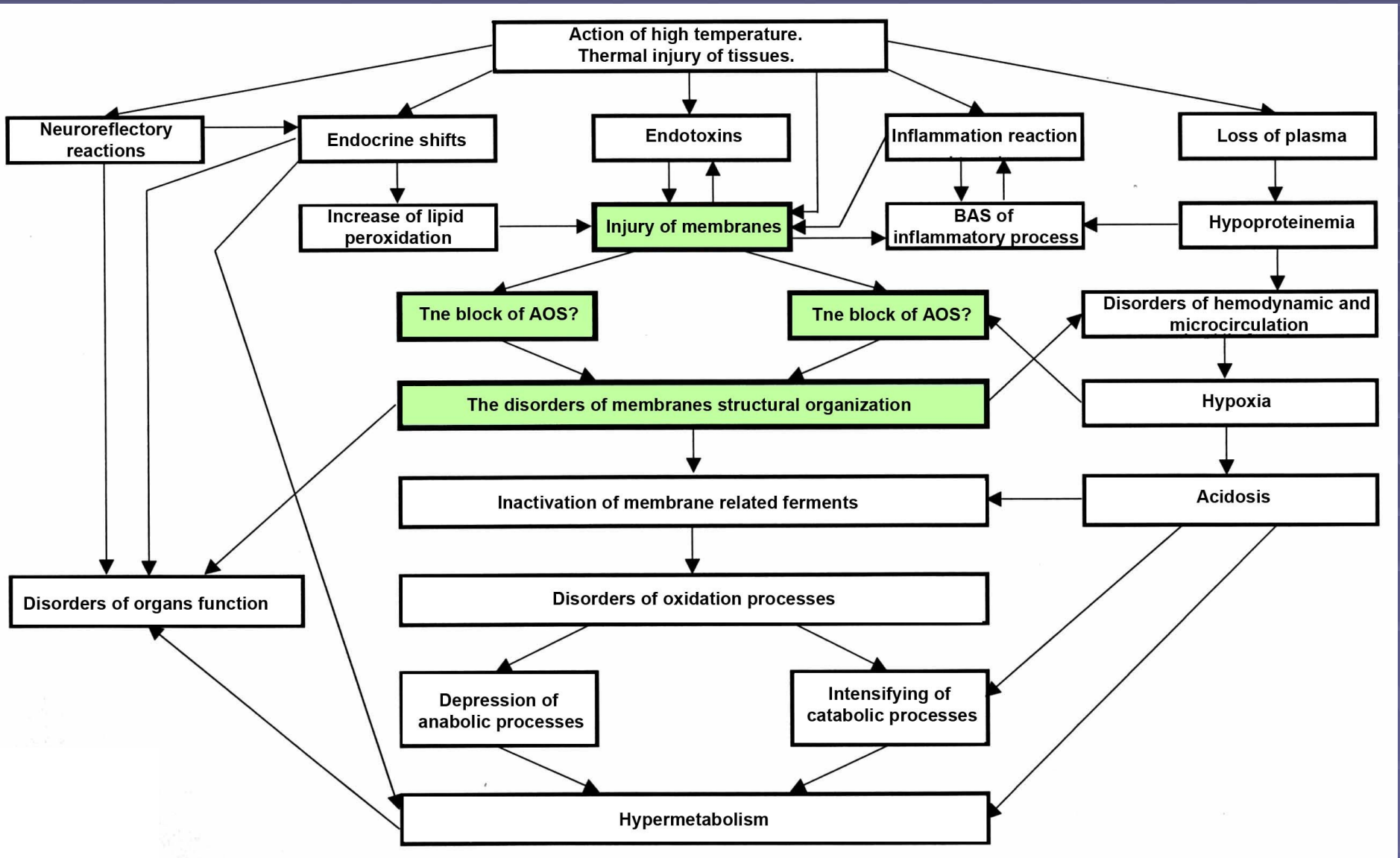
Capillary stasis. Output of plasma and proteins out of the capillaries. The edema of interstitial space.

Hypo- and anoxia, irreversible changes of tissues and organs.

Reactivation of oxygen homeostasis with ozone



- It is shown in the scheme that one of the major aspects of pathogenesis of burn disease is oxidative stress with disorders of balance of pro- and antioxidant systems
- The starting aspect of organism readaptation against the background of ozonotherapy is optimization of pro- and antioxidant balance of organism:



- The proof of this theory is the discovery certified by the International Academy of Scientific Discoveries and Inventions which shows that small concentrations of ozone are capable of restarting abnormal pro- and antioxidant potential with subsequent restoration of oxygen homeostasis of organism.



Российская академия естественных наук

Международная академия авторов научных открытий и изобретений
Международная ассоциация авторов научных открытий

ДИПЛОМ № 309
на открытие

**«ЗАКОНОМЕРНОСТЬ ФОРМИРОВАНИЯ АДАПТА
МЕХАНИЗМОВ ОРГАНИЗМОВ МЛЕКОПИТА
ПРИ СИСТЕМНОМ ВОЗДЕЙСТВИИ
НИЗКИМИ ТЕРАПЕВТИЧЕСКИМИ ДОЗАМИ С**

Международная академия авторов научных открытий и изобретений
на основании результатов научной экспертизы
заявки на открытие № А-387 от 9 февраля 2006 г.

*ПОДТВЕРЖДАЕТ УСТАНОВЛЕНИЕ
НАУЧНОГО ОТКРЫТИЯ*

**«ЗАКОНОМЕРНОСТЬ ФОРМИРОВАНИЯ АДАПТАЦИОННЫХ
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НИЗКИМИ ТЕРАПЕВТИЧЕСКИМИ ДОЗАМИ ОЗОНА»**

Авторы открытия:

**ПЕРЕТЯГИН СЕРГЕЙ ПЕТРОВИЧ
КОНТОРЩИКОВА КЛАВДИЯ НИКОЛАЕВНА**

Формула открытия

Установлена неизвестная ранее закономерность формирования адапционных механизмов организмов млекопитающих при системном воздействии низкими терапевтическими дозами озона, заключающаяся в пусковом влиянии действия терапевтических зон озона на про- и антиоксидантный баланс организма и обусловленная интенсификацией свободнорадикальных реакций, увеличивающей активность ферментативного и неферментативного звеньев антиоксидантной системы защиты.

Приоритет открытия

сентябрь 1989 г. - по дате сообщения «Positive therapeutic effect of prooxidant properties» на Международной конференции «Regulation of free radical reactions» (Bulgaria, Varna, 1989).

На основании установленных в соответствии с действующим законодательством правовых положений Устава Международная академия авторов научных открытий и изобретений выдала настоящий диплом на открытие *«Закономерность формирования адапционных механизмов организмов млекопитающих при системном воздействии низкими терапевтическими дозами озона»*

ПЕРЕТЯГИНУ СЕРГЕЮ ПЕТРОВИЧУ

Президент Российской академии
естественных наук

О.Л. Кузнецов

Президент Международной академии
авторов научных открытий и изобретений

В.В. Потоцкий

« 10 » 1999 2006 г.
г. Москва. Регистрационный № 387

Physiological and therapeutic effects of ozonotherapy

Moderate “physiological” activation of free radical reactions of lipid peroxidation.

Support of activity of respiratory chain.

Stimulation of biosynthesis of biologically active substances (hormones, prostaglandins, leukotrienes, thromboxane A₂, progesterone, collagen, ozonolysis, stimulation and improvement of metabolism of amino acids.

Regulation of processes of restoration of nervous tissue after irritation

Ozone and ozonides can play the role of “molecular phags” which promote the destruction of germs, phagocytosis, clearing of the zones of injury.

Ozonides participate in production of chemotaxic factor which cause migration of leucocytes in the focus of inflammation.

Ozone and ozonides are co-factors of biosynthetic processes.

Ozone and ozonides are activators of oxygen related ferments.

Ozone renders therapeutic action through the physiological effects of lipid peroxidation till some activation of lipid peroxidation is compensated by adequate changes of all the links of the antioxidizing system.

Physiological and therapeutic effects of ozonotherapy

Intensification of bioenergetic processes

Activation of oxidative phosphorylation and stimulation of energy production in tissues

Maintenance of high level of cellular respiration by induction of activity of the major ferments of respiratory chain.

Activation of detoxification processes

Inhibition of toxic metabolites production (lactate, pyruvate), activation of destruction and utilization.

Stimulation of metabolic protective systems.

Modelling of monooxygenase systems.

Activation of biosynthetic regenerative processes

Releasing of cytokines from fibroblasts and epitheliocytes (transforming growth factor, basic fibroblast growth factor, monocyte chemotactic protein, keratinocyte growth factor) and thus stimulation of restoration of epidermal layers.

**The indications
for local treatment
of burn wounds
are as follows:**

Local application of ozone in the treatment of burn wounds

The aims and objectives	Mechanisms of therapeutic action	Clinical effects
<ol style="list-style-type: none">1. Control of inflammation2. Elimination of infection3. Reduction of time of wound healing	<ol style="list-style-type: none">1. Bactericide2. Virocide3. Fungicide4. Stimulation of reparative and regenerative processes5. Intensification of microcirculation in the area of wound surface6. Intensifying wound surface oxygen supply	<ol style="list-style-type: none">1. In IIIA degree burns necrolytic action by 5 days without use of necrectomy2. In IIIB degree burns it is possible to complete cleaning of wounds after necrectomy without use of enzymatic preparations3. Improvement of tissue trophicity4. Increase of viability of paranecrotic area tissues5. Faster reduction of the area of granulating wound

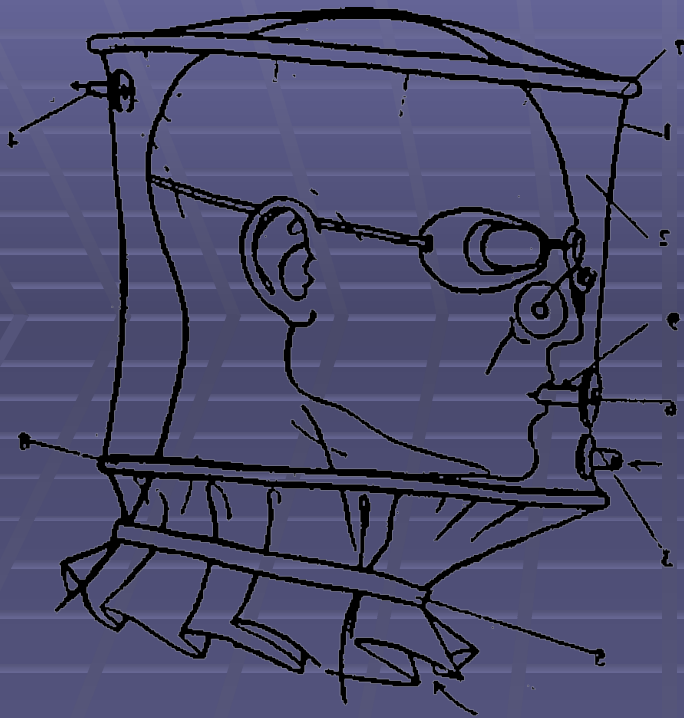
The methods of ozone local application in the treatment of burn wounds

1. Irrigation with ozone in plastic bags
2. Subcutaneous and intramuscular injections of ozone
3. Processing of the wounds with ozonised antiseptic solutions including hydropressive processing with removing of necrotic tissues, wet-to-dry dressings with ozonised antiseptic solutions
4. Irrigation in low pressure or in the mode of pressure change from vacuum to increase of pressure
5. Ozonised baths both local and general
6. Vacuum massage with ozonised olive oil of the skin adjacent to the wound areas
7. The decubitus prevention
8. Drinking ozonised water and intestinal irrigations
9. Intraarticular injections of ozonised gas mixture
10. Acupunctural ozonotherapy
11. Applications of ozonised olive oil

Processing of the wounds with ozonised antiseptic solutions including hydropressive processing with removing of necrotic tissues (УГОР - 1)

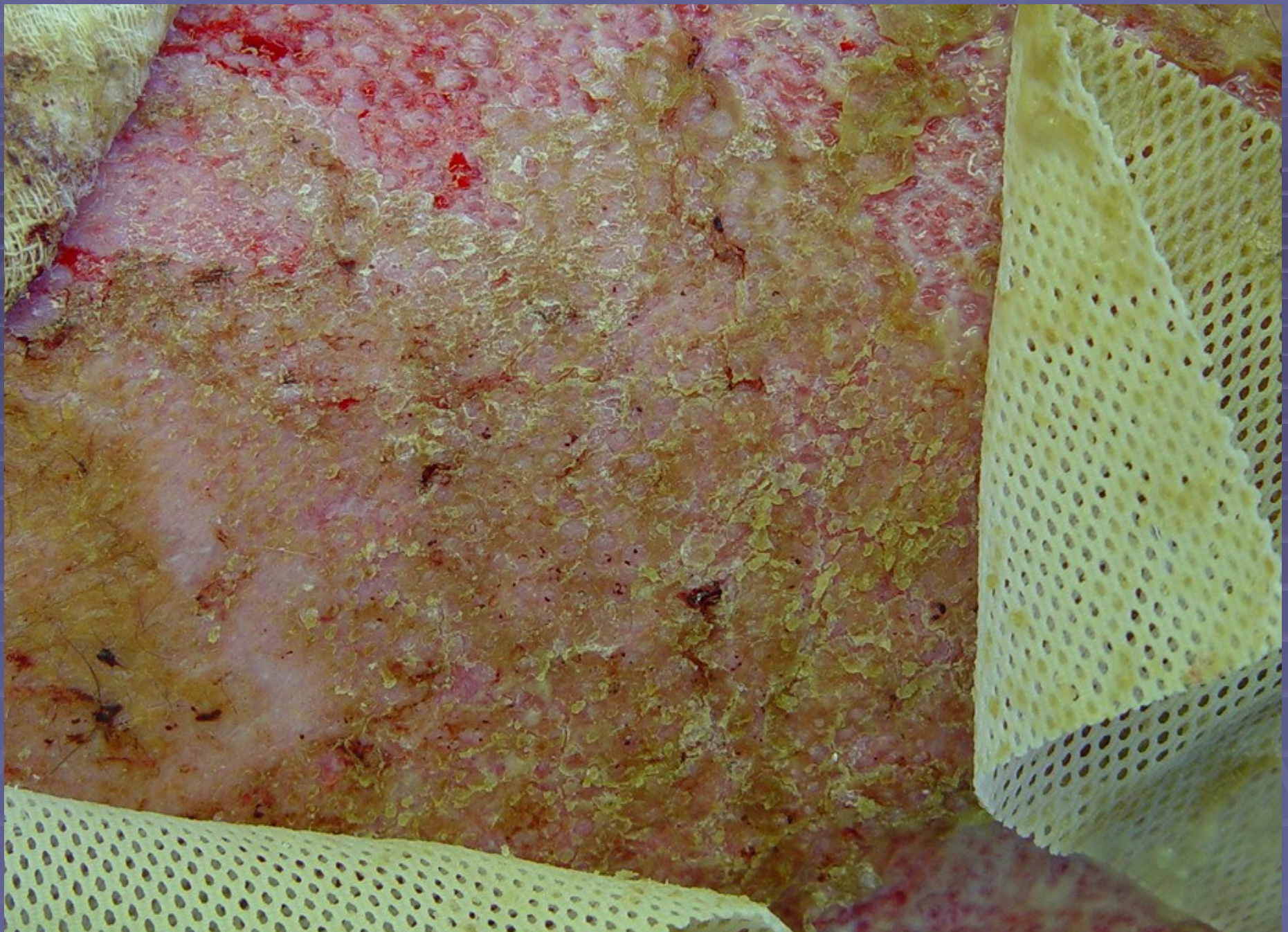


**The example
of external ozonotherapy
application
in thermal trauma of the head:**



The examples of external ozonotherapy application combined with meshed cover

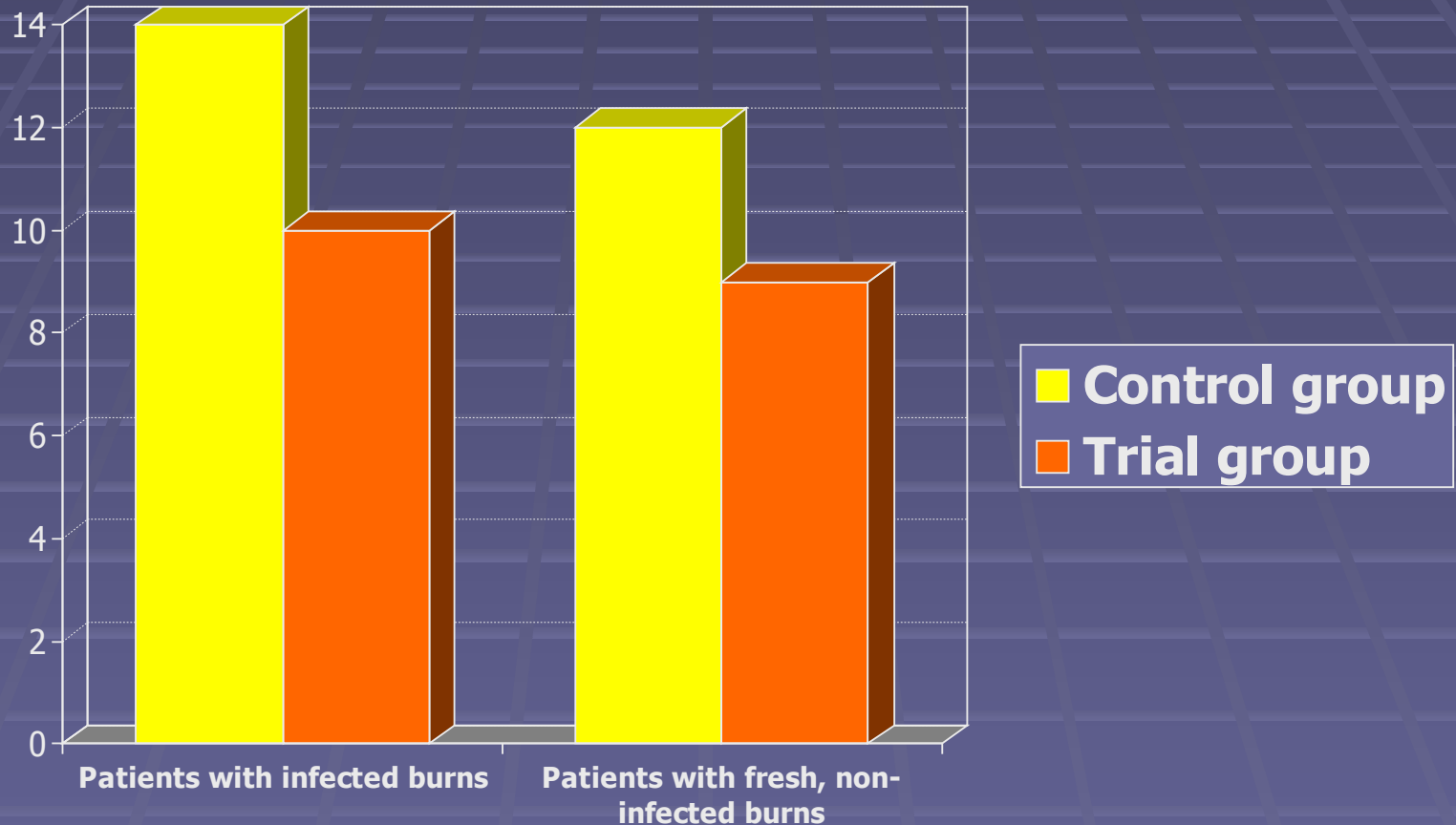
- 1 wound healing under the meshed cover
- 2 comparing betwing two wound parts: dressing covered part has healed, the non covered part has not healed





Ozonotherapy and wound covering

Distribution of the patients according to the time of healing and the influence of wound infection



Systemic ozonotherapy

- The methods of systemic ozonotherapy render multifactor therapeutic effect on the organism by ozonolytic products of organic substances. These may be direct reactions of ozone with carbohydrates, amino acids, fatty acids, and prolonged influence on homeostasis through the circulation of ozonides.
- As a result of these interactions, a lot of biologically active products appear in the organism which render therapeutic effects.

Ozonolysis of internal environment (ozonised saline, major autohemoozonotherapy)

Primary reactions with organic substances.

Indirect influence (ozonides.)

Carbohydrates.

Proteins (amino acids).

1. Direct oxidation of glycoside linkages of polysaccharides.
2. Intensifying of glucose metabolism.
3. Formed 5-carbohydrates are used for synthesis of nucleotides
4. Increasing of oxygen-transport function of erythrocytes

Tryptophan.

Serotonin.

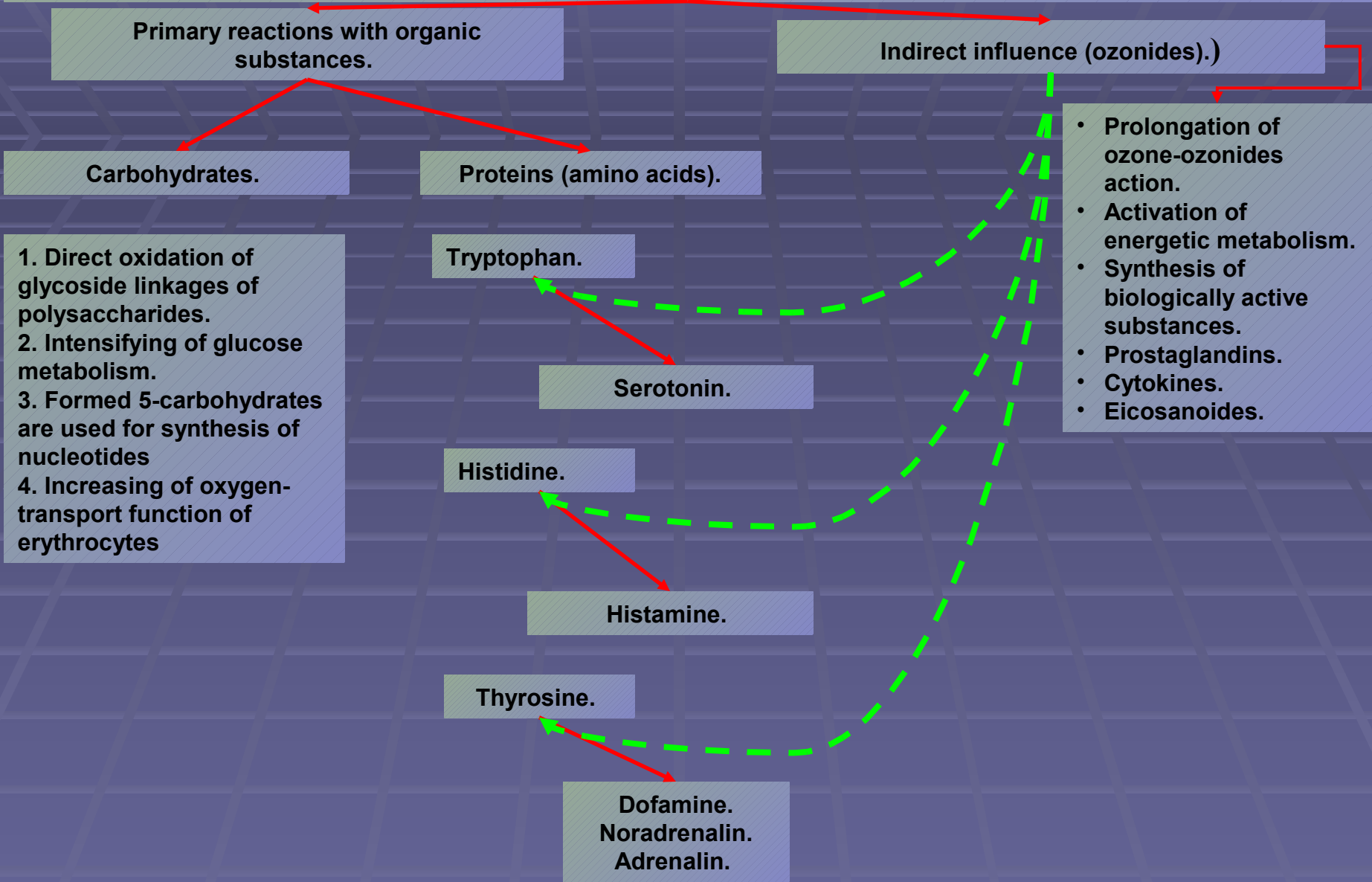
Histidine.

Histamine.

Thyrosine.

Dofamine.
Noradrenalin.
Adrenalin.

- Prolongation of ozone-ozonides action.
- Activation of energetic metabolism.
- Synthesis of biologically active substances.
- Prostaglandins.
- Cytokines.
- Eicosanoides.



Methods of systemic ozonotherapy:.

1. Intravenous infusions of ozonised saline.
2. Major autohemotherapy with ozone.
3. Low flow extracorporeal processing of the big blood volumes with ozone.
4. Ozone rectal insufflations.
5. Transfusions of ozonised blood and plasma

Intravenous infusions of ozonised saline.



Major autohemotherapy with ozone.





Major
autohemotherapy
with ozone.

Low flow extracorporeal processing of the big blood volumes with ozone.



Low flow extracorporeal processing of the big blood volumes with ozone.



- The following biochemical parameters prove the effectiveness of systemic ozonotherapy
- General antioxidant activity of the blood.
- Reduction of hyperenzymaemia (ALT, AST)
- Increasing of glucose consumption
- Reduction of urea, creatinine, bilirubin, middle molecules

Dynamics of lipid peroxidation and antioxidant activity according to the methods of treatment

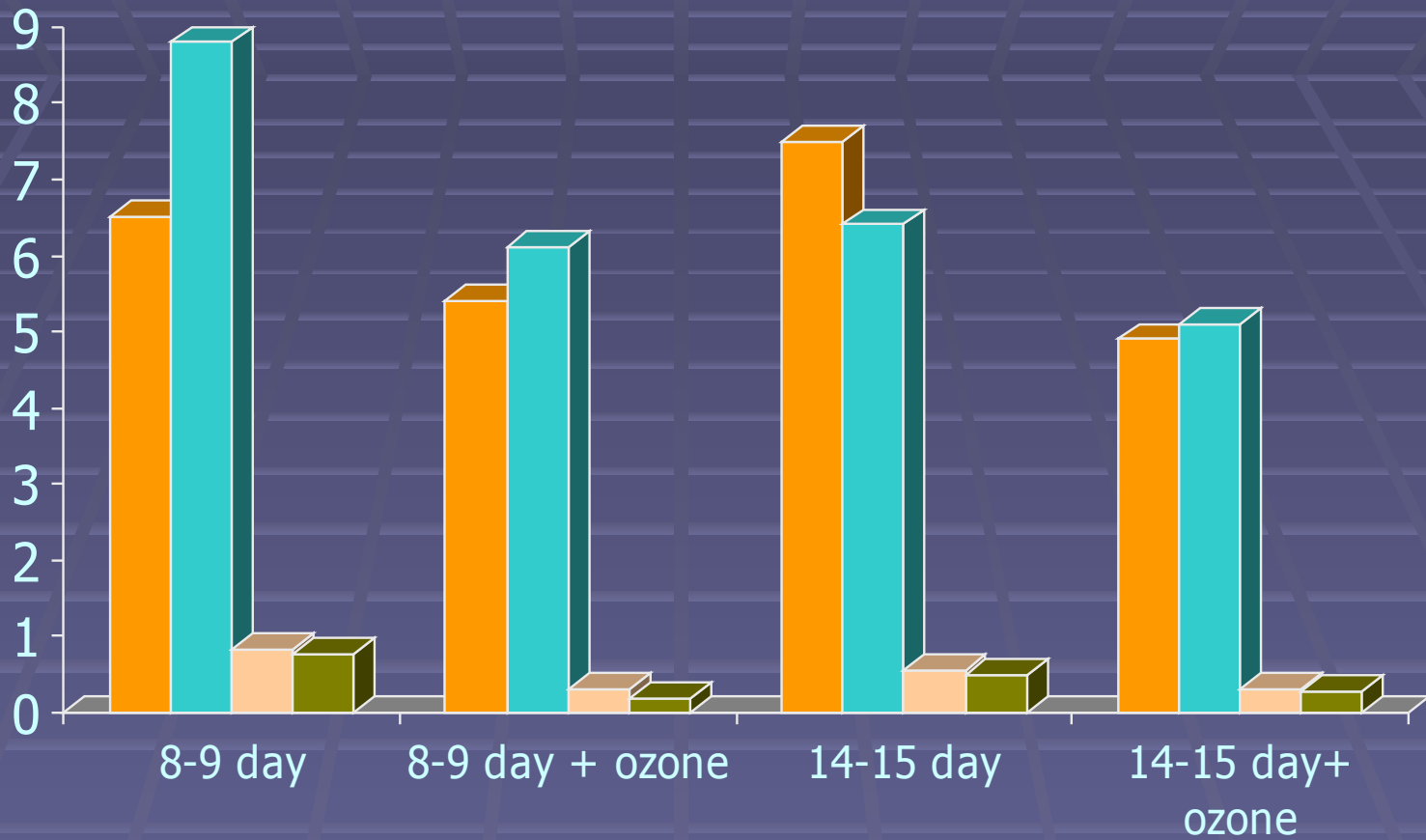
		3-4 th day	8-9 th day	14-15 th day
ПОЛ (S, mV) 12,0±2,0	Control	26,3±3,94	22,09±4,39	28,4±2,86
	Ozone		23,98±2,64	23,8±1,78
АОА (усл.ед.) 0,55±0,85	Control	0,473±0,111	0,438±0,105	0,444±0,084
	Ozone		0,558±0,079	0,82±0,182
ПРЭ (S, mV) 8,3±0,8	Control	12,40±0,89	11,51±0,12	9,3±0,28
	Ozone		9,45±0,73	8,81±0,58
ДК (ед.опт.пл./мг ОЛ) 0,02-0,08	Control	0,095±0,002		0,097±0,001
	Ozone			0,12±0,02
ТК (ед.опт.пл./мг ОЛ) 0,05-0,35	Control	0,017±0,001		0,018±0,001
	Ozone			0,12±0,02
ОШ (отн.ед../мг ОЛ) 1,5-4	Control	13,20±3,40		15,3±4,02
	Ozone			17,04±4,18

Dynamics of parameters according to the method of treatment

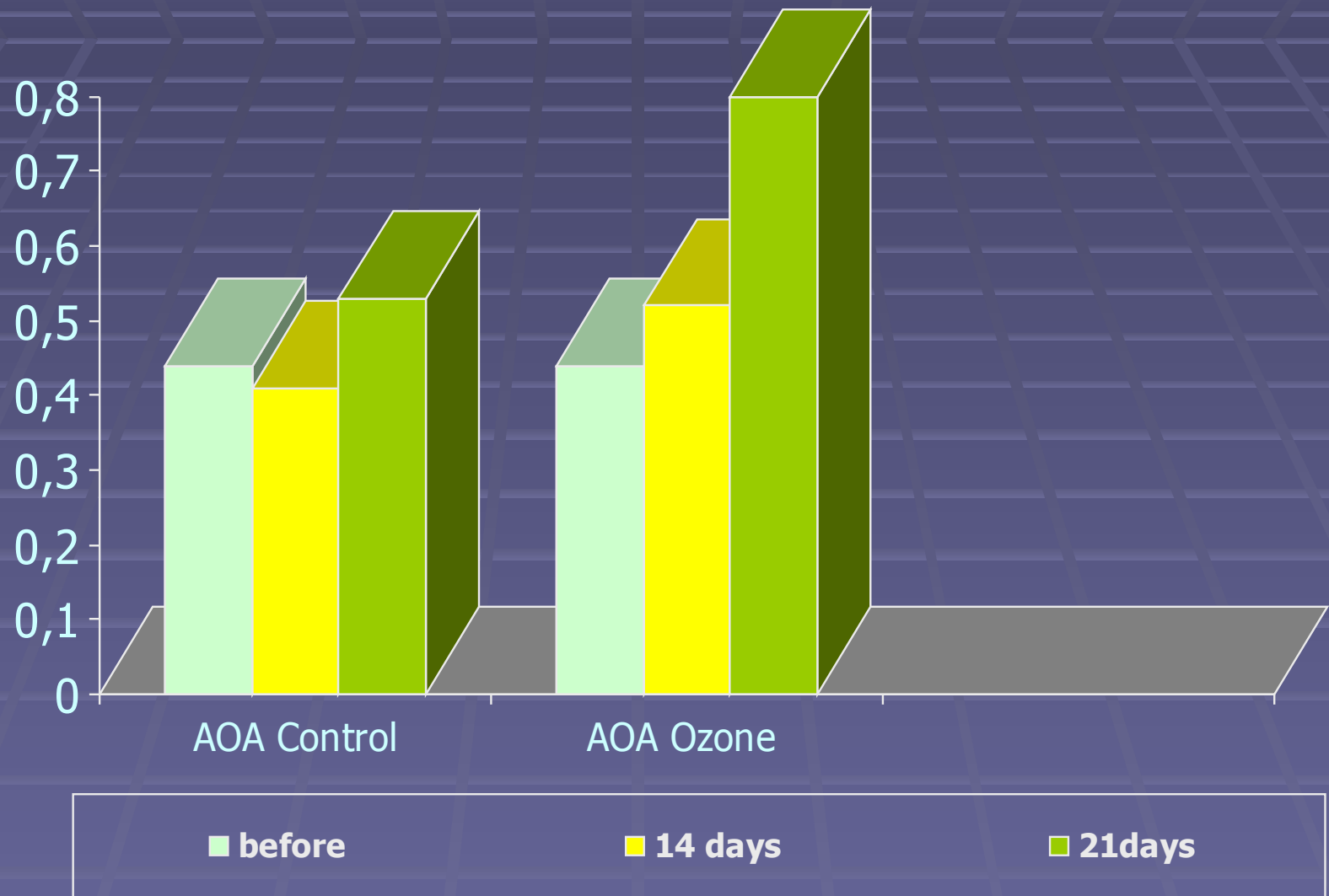
		3-4 th day	8-9 th day	14-15 th day
Tot. protein 60-83 g/l	Control	53,7±2,25	56,16±2,88	63,36±4,45
	Ozone		63,96±3,37	65,50±4,28
Albumin 35-53 g/l	Control	27,7±0,68	24,93±1,17	29,25±2,21
	Ozone		30,74±1,73	29,91±1,25
ALT 5-49 u/l	Control	38,93±1,71	20,12±3,60	38,41±9,56
	Ozone		33,86±7,10	26,87±5,55
AST 9-48 u/l	Control	51,50±1,40	39,8±2,90	95,31±12,42
	Ozone		53,76±14,56	41,33±4,75
Glucosa 3,6-6,1	Control	6,89±0,87	6,53±0,72	7,44±1,10
	Ozone		5,43±0,54	4,90±0,38
BUN 2,5-6,43 mmol/l	Control	4,94±0,68	8,80±1,77	6,41±0,84
	Ozone		6,11±0,85	5,06±0,26

Dynamics of parameters according to the method of treatment

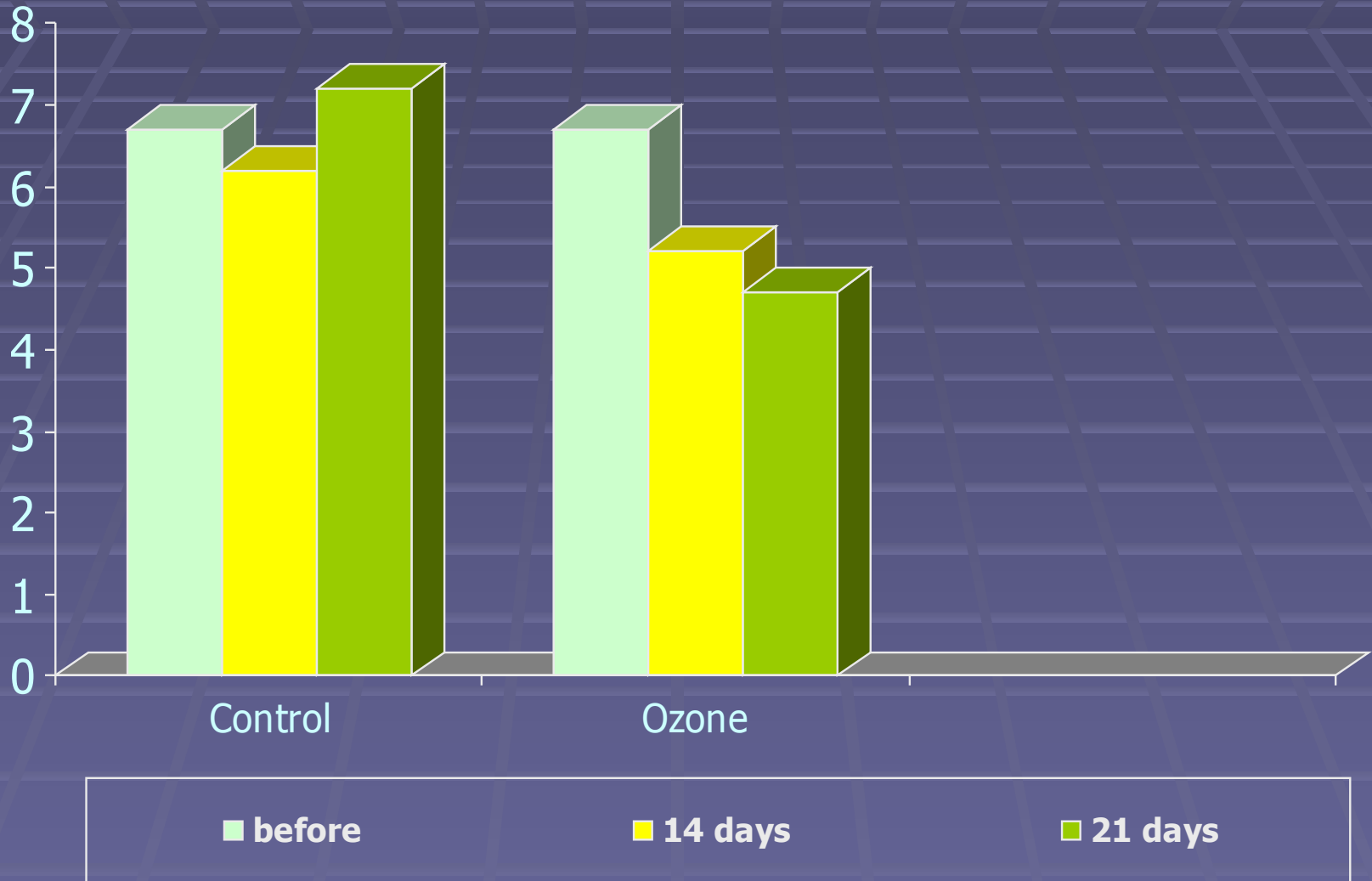
		3-4 th day	8-9 th day	14-15 th day
Creatinine, 62-132	Control	238±22	111,7±16,1	275±28,8
	Ozone		76,9	70,4
MMP . E 280 0,15-0,37	Control	0,58±0,02	0,77±0,08	0,5±0,02
	Ozone		0,19±0,02	0,28±0,01
MMP . E 254 0,15-0,22	Control	0,6±0,03	0,83±0,09	0,55±0,08
	Ozone		0,3±0,01	0,3±0,01
L II - 1,2	Control	2,6 ±0,7	2,71±0,6	2,5±0,6
	Ozone		1,7±0,4	1,5±0,3
Total bili 3,42 -17,20	Control	23,3±9,4	7,6±1,9	7,9±1,4
	Ozone		7,8	
Direct bili 0- 3,42	Control	3,9±0,5	1,6	1,7
	Ozone		1,2	1,0



Comparative analysis of AOA dynamics according to the method of treatment

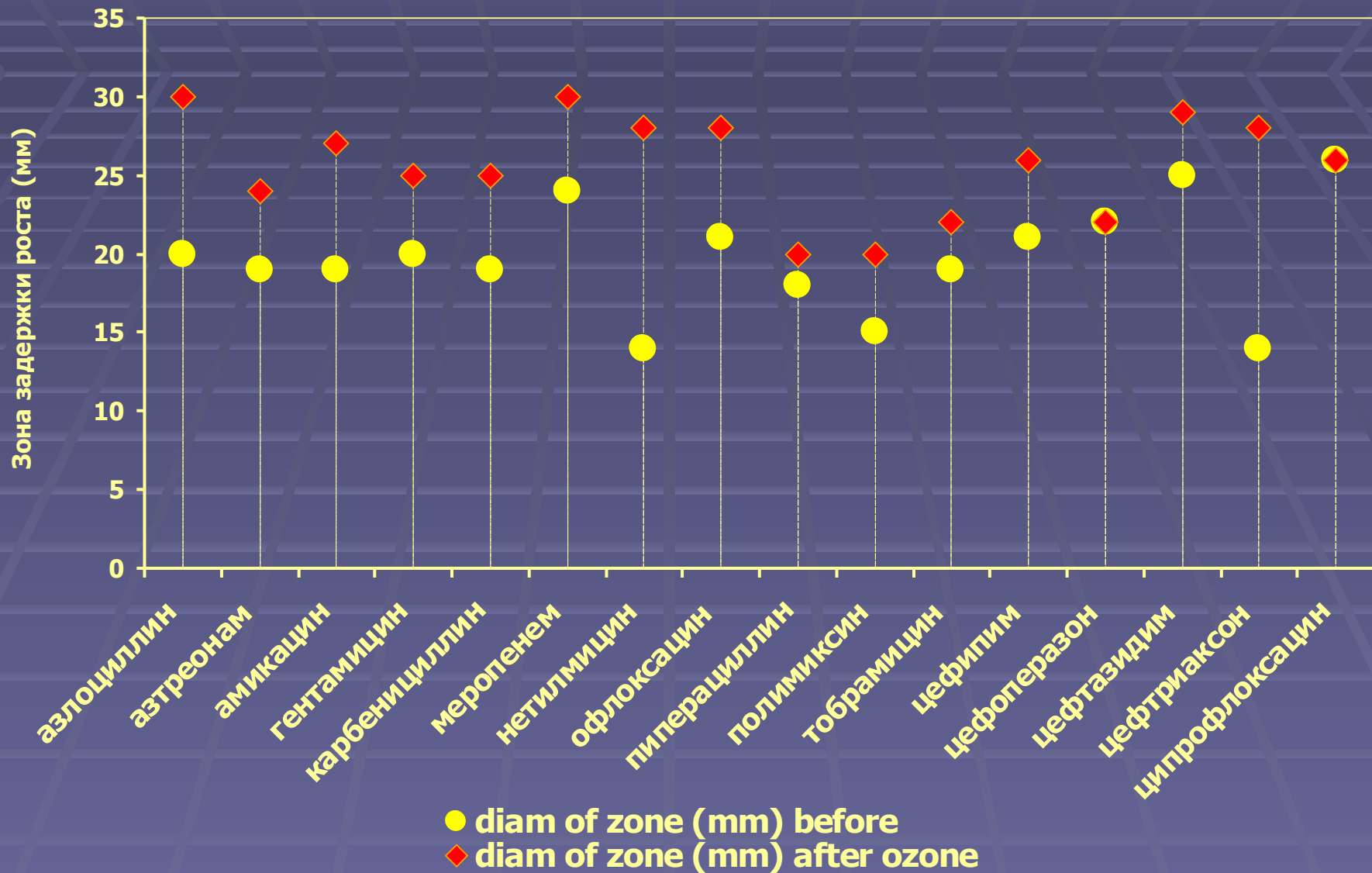


The changes of glucose content in the blood of burn disease patients



One of the important positive aspects of systemic ozonotherapy is increasing of the sensitivity of microflora to antibiotics

The changes of sensitivity to antibiotics of *Pseudomonas aeruginosa* from the animal with a burn complicated by blue-green pus infection after the introduction of ozonised saline in concentration of ozone 1000 mkg/l



- The use of ozonotherapy after restoration of skin surface in a remote period allow to control the complications of the burn trauma



- Subcutaneous injections
№10
3000mkg/l

Osonated
olive oil
applications



- The technology of ozonotherapy in traumatology and orthopaedics is certified in our country by the sanction of Russian Ministry of Health Care concerning the use of ozone

**Thank you
for your attention**