



Activated carbons in treatment of acute radiation sickness: achievements and prospects

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The risk of radiation exposure of population due to radiological terrorism and radiological accidents is increasing worldwide.

***What's about medical countermeasures*?**

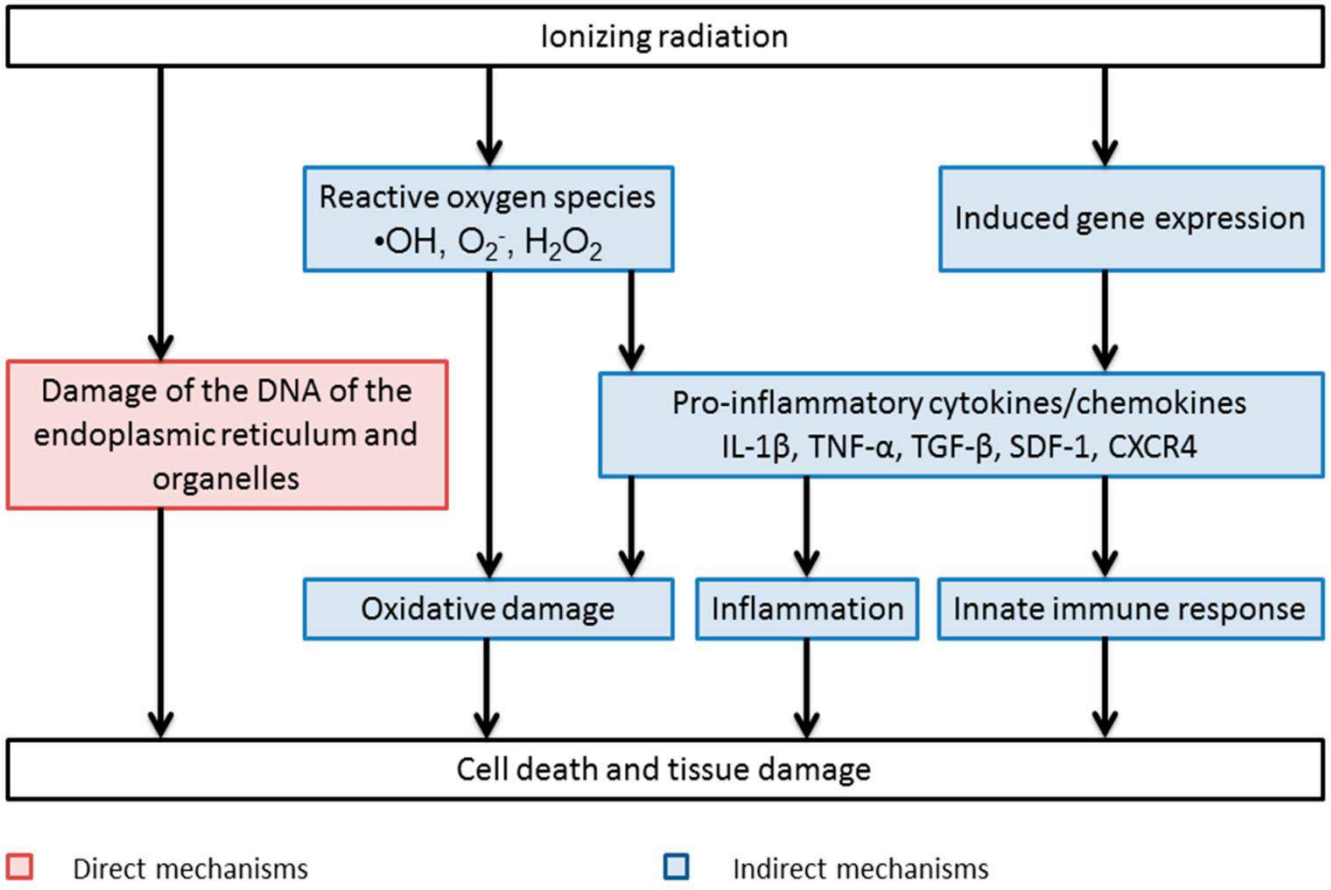
According to the FDA there are no infallible methods for effective countermeasures (MCM) to irradiation exposure.

Today the main **specific** therapeutic principles are:

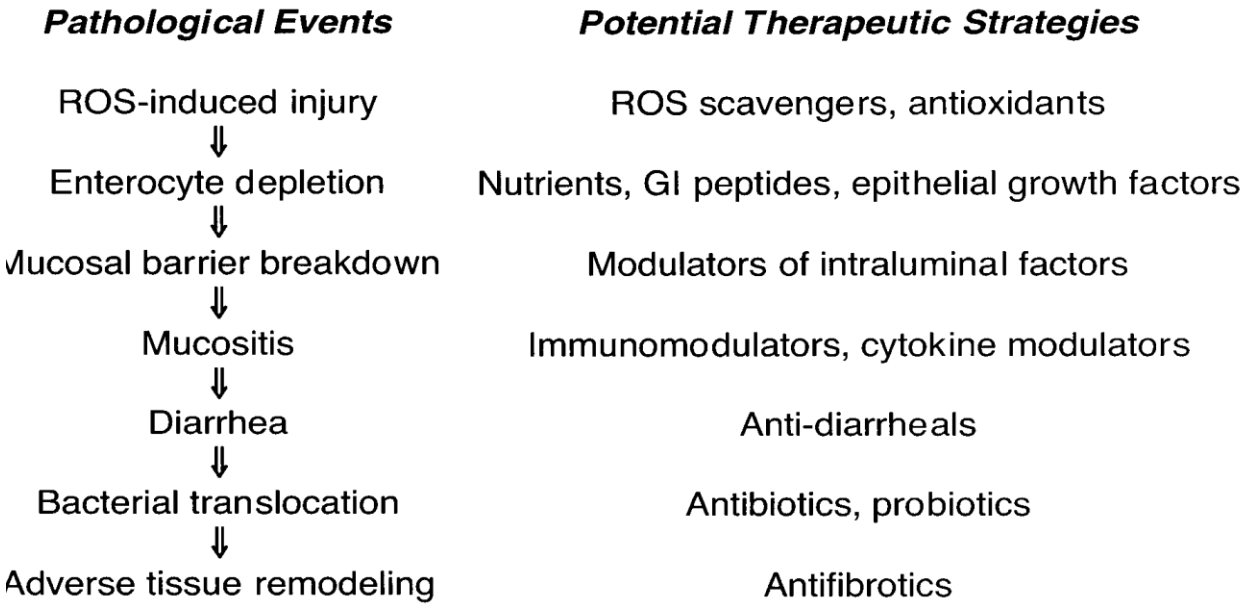
- replacement with blood products

-administration of cytokines like G-CSF and GM-CSF

-transplantation of hematopoietic stem cells

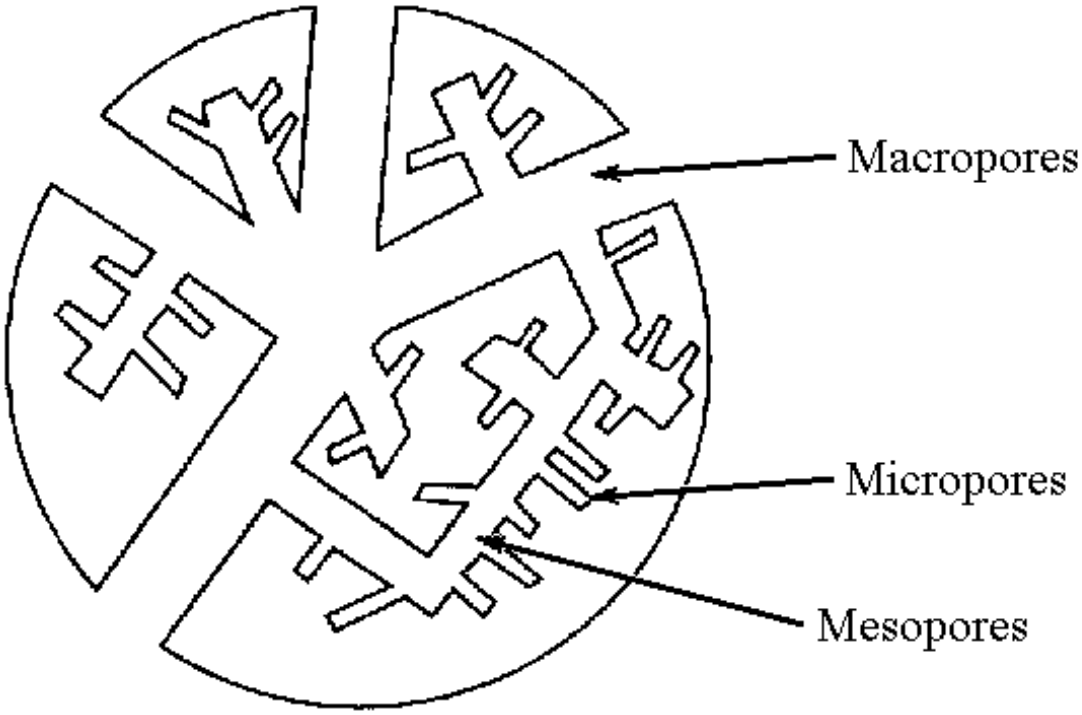


Susan Hall , Santosh Rudrawar, Matthew Zunk , Nijole Bernaitis , Devinder Arora , CatherineM McDermott and Shailendra Anoopkumar-Dukie Antioxidants Protection against Radiotherapy-Induced Toxicity **2016**, 5, 22; doi:10.3390/antiox5030022



Helen B. Stone, John E. Moulder, C. Norman Coleman et al
Models for Evaluating Agents Intended for the Prophylaxis, Mitigation and Treatment of Radiation Injuries. Report of an NCI Workshop, December 3–4, 2003. Radiation Research 162, 2004

Porosity of activated carbon
(from F.Rodriguez-Reinoso, *Carbon*, 1998)



Hemoperfusion in dogs 1977



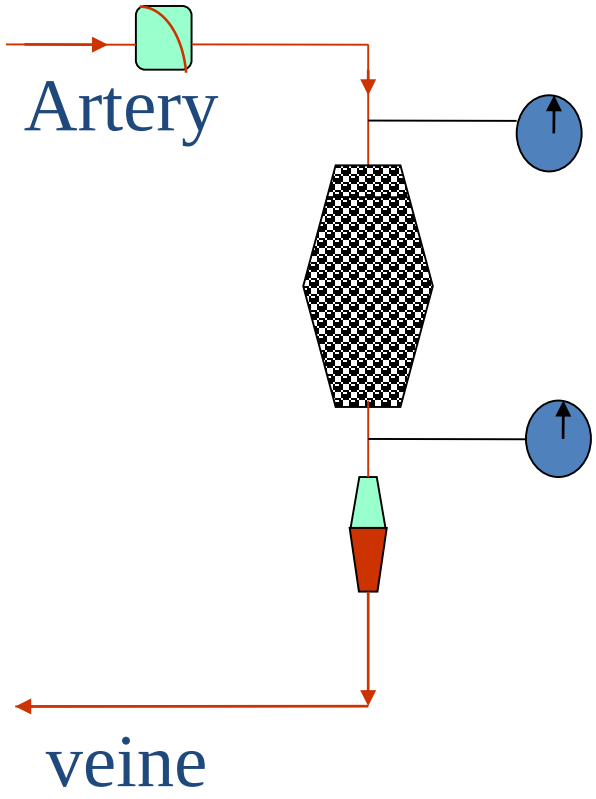
Irradiated control



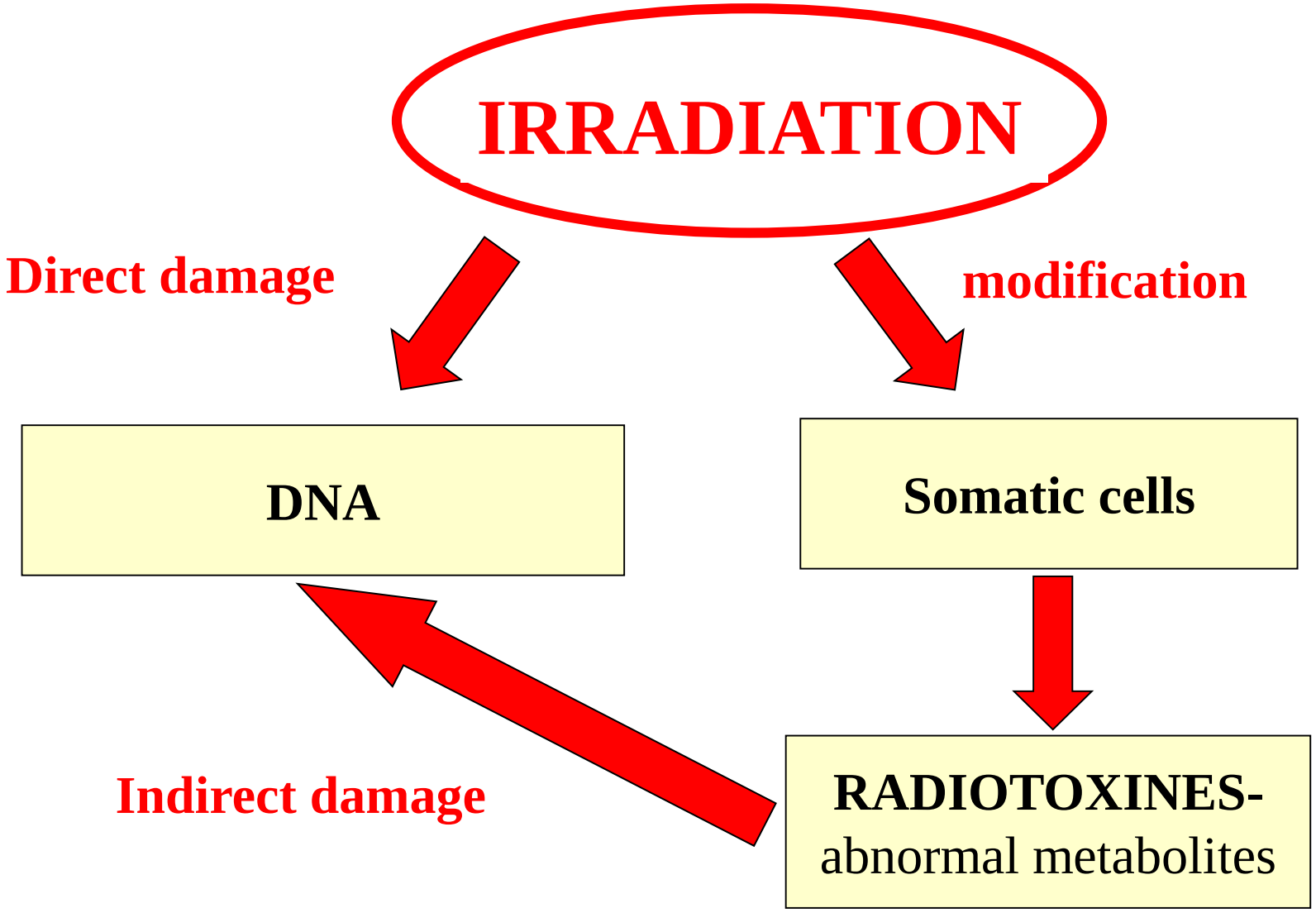
2h after

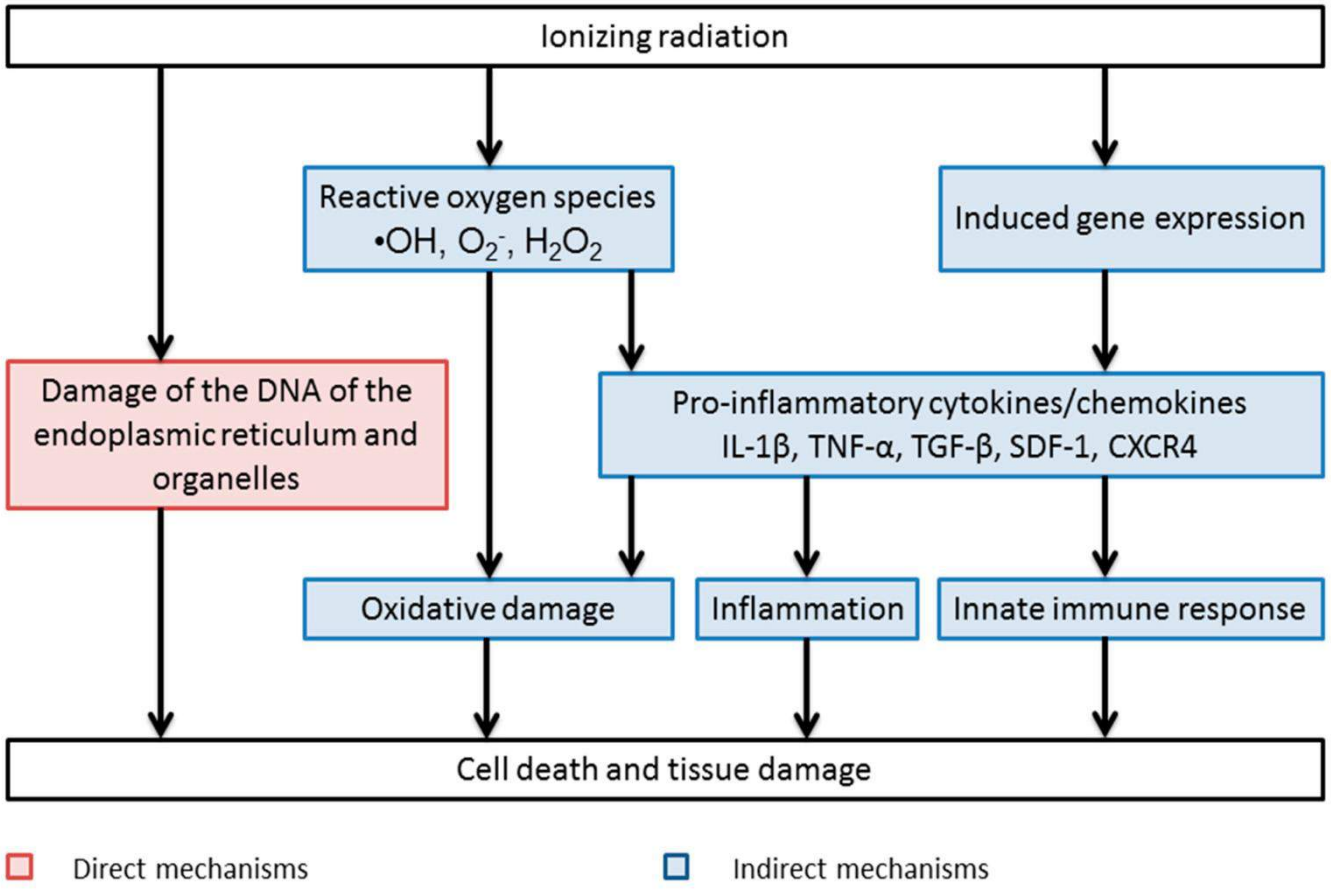


24h after



Hypothesis Kuzin AM, USSR, 1970 on irradiation action





Susan Hall , Santosh Rudrawar, Matthew Zunk , Nijole Bernaitis , Devinder Arora , CatherineM McDermott and Shailendra Anoopkumar-Dukie Antioxidants Protection against Radiotherapy-Induced Toxicity **2016**, 5, 22; doi:10.3390/antiox5030022

EFFECT OF HAEMOPERFUSION (HP) ON ACUTE RADIATION SICKNESS IN DOGS

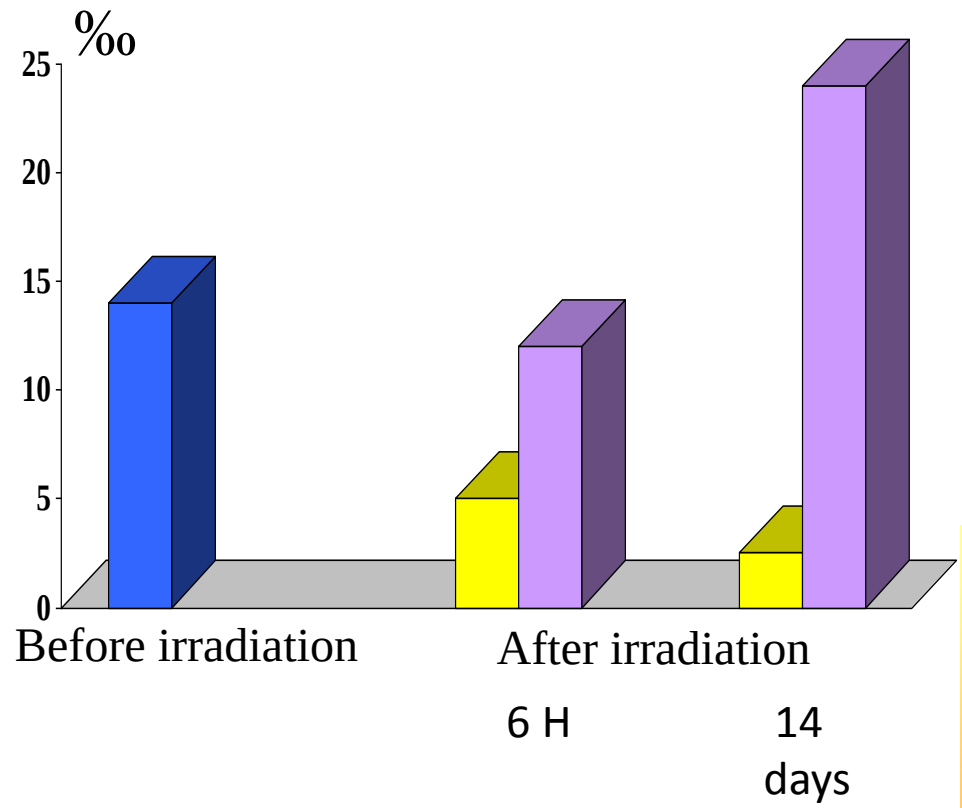
Group	**Survival , %**
Control (n=31)	3,2
HP 2 hours after irradiation (n=19)	68,4
HP 24 hours after irradiation (n=19)	62,4

Mongrel dogs, 8-12 kg weight, exposed to X-rays, 5,25 Gu
All animals received antibiotics and human serum albumin transfusion as a basic conventional therapy. The 3rd group additionally had one session of massive saline transfusion, following diuretic furosemide prescription.

[Nikolaev V.G., Pinchuk L.B., Umansky M.A., et al. Early Experimental Studies on Hemoperfusion as a Treatment Modality for Acute Radiation Disease. Artif Organs, 1993, 17, 5, P.362-365]



Index of bone marrow cells division in dogs exposed to lethal dose of irradiation -5.25 Guy.



- group treated 2 h after Ir n=19

-group non treated n= 31

Division of cells in bone marrow of animals treated with HP is high

Mechanisms of Activated carbon's action in hemoperfusion:

examples :

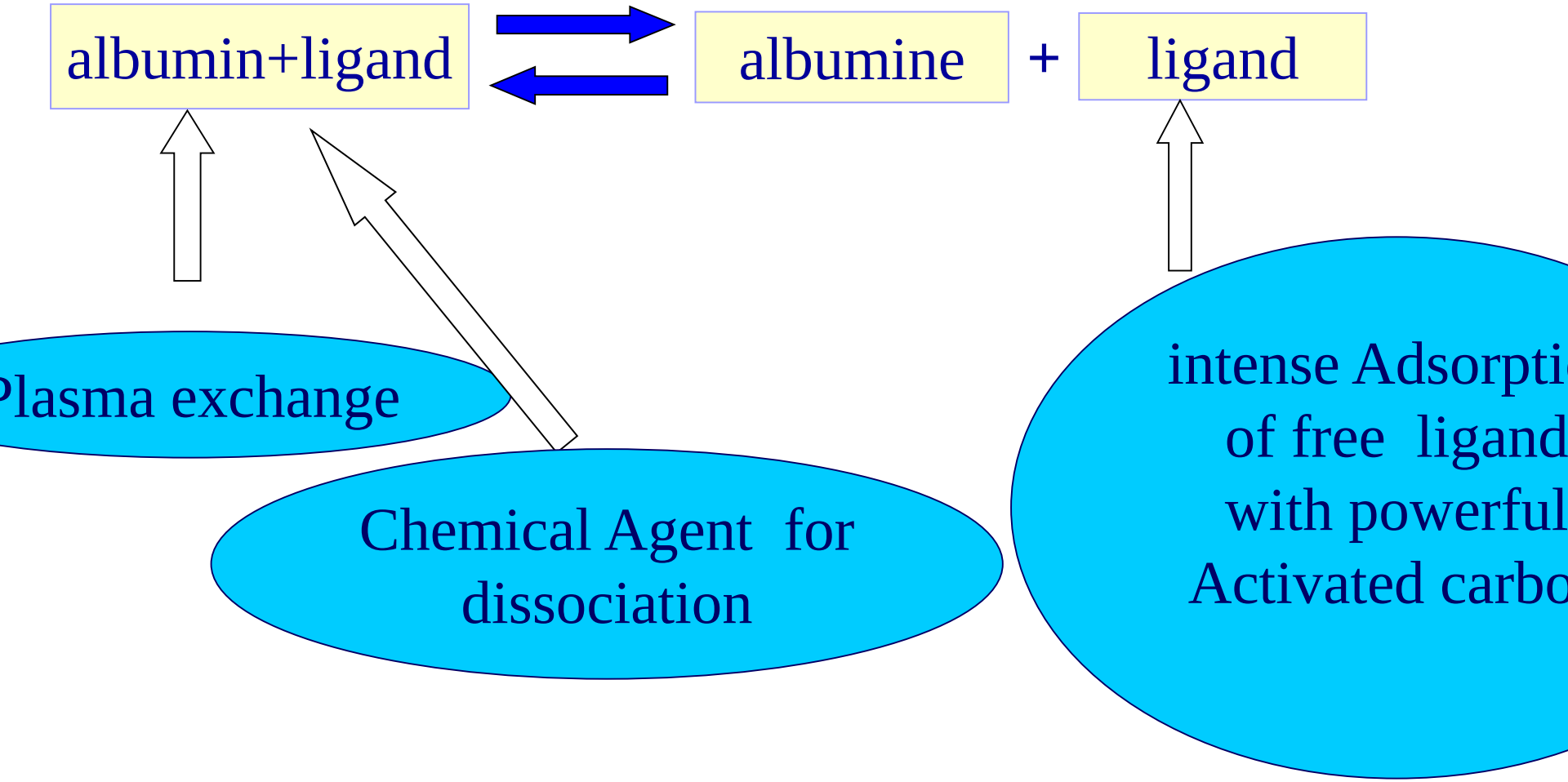
- **Adsorption of cytokines**
- **Purification of plasma albumin**

Residual concentration of inflammatory cytokines (1000 pg/ml in 3%BSA solution) after contact with uncoated, DNA or dextran-sulphate coated carbonic adsorbents

Cytokines residual concentration, pg/ml			
Activated Carbon with surface area value S_{BET}	**TNF-α, pg/ml**	**IL-1β, pg/ml**	**IL-6, pg/ml**
Adsorba 300 C , 900 m^2/g	705,0 ± 200,6	994,0 ± 12,0	957,0 ± 48,5
SCN, 1250 m^2/g	752,1 ± 196	658,1 ± 167,8	575,6± 76,6
HSGD, 2300 m^2/g	76,4 ± 62,5^{A}	26,4 ± 39,4^{A}	61,9 ± 19,0^{A}
HSGD+DNA ,2 200 m^2/g	21,3 ± 15,7^{A}	0,5 ± 0,95^{A}	14,7 ± 10,5^{AB}
HSGD+dextran , 2200 m^2/g	75,5 ± 41,9^{A}	14,8 ± 29,2^{A}	14,1 ± 12,0^{AB}

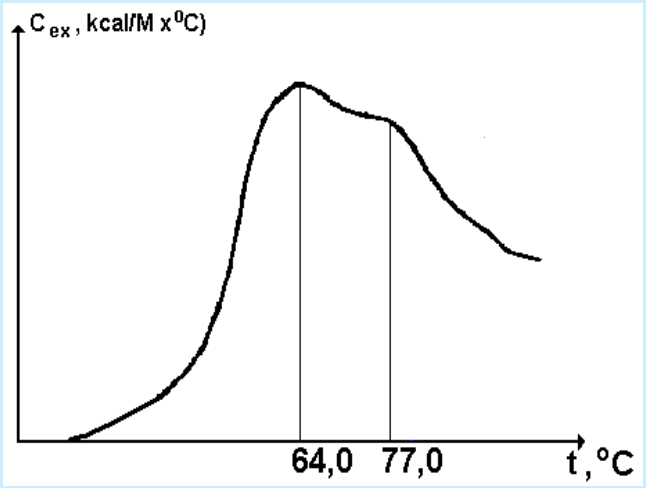
A - $p<0,05$ in comparison with SCN

AB - $p<0,05$ in comparison with HSGD

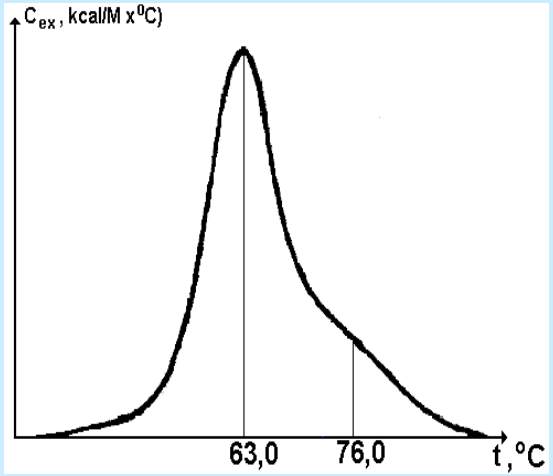


By what whay dissociate the albumin+ligand complex?

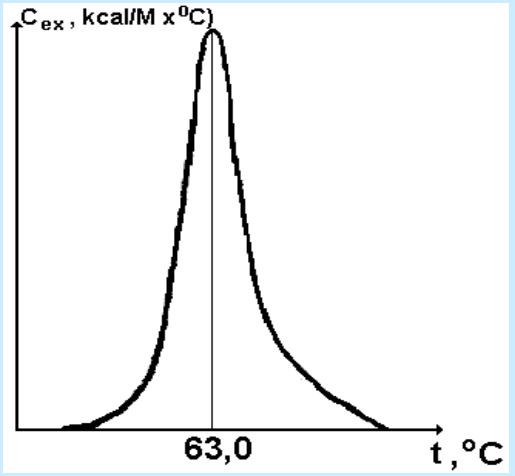
Melting thermograms of HSA-Bilirubin Complex Before and After Purification onto HSGD Carbons



bilirubin/albumin molar ratio
= **0,74**



bilirubin/albumin molar ratio
= **0,0024**



defatted human serum albumin

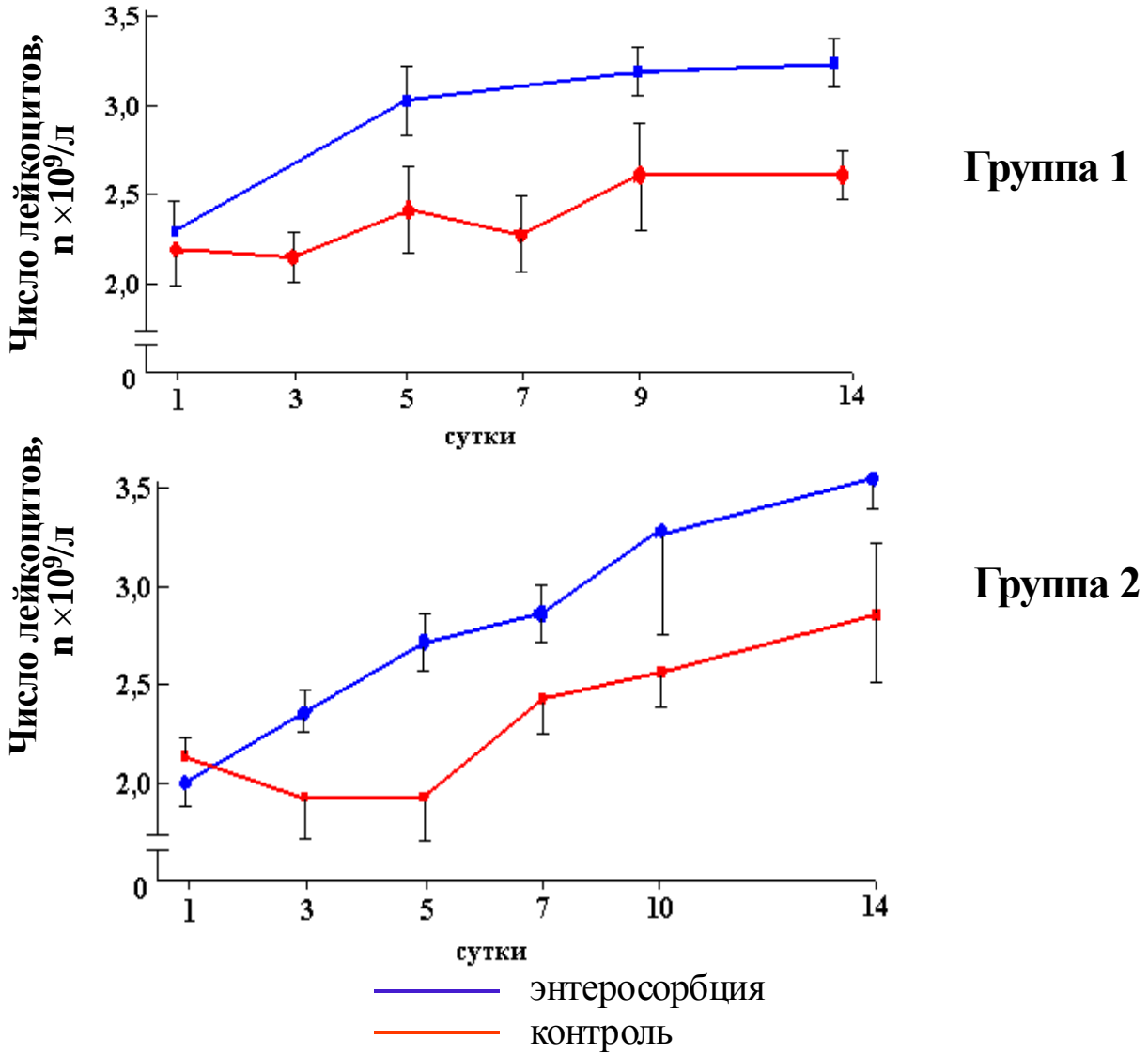
Enterosorption
is the method of detoxification therapy,
consisting **in the oral intake** of
enterosorbents,
which
eliminates from the gastrointestinal tract
exogenous and endogenous toxins
and
serves to modify the lipid and amino acid spectrum
of the intestinal contents.



7-8 L of blood filtrate
enter daily
in our gastrointestinal tract :

- Mucus-1,5 L
- Gastric juice-1,5-2 L
- Bile-0,5-0,6L
- Intestinal Juice-3 L

ЛЕЙКОСТИМУЛИРУЮЩИЙ ЭФФЕКТ ЭНТЕРОСОРБЦИИ У ОНКОЛОГИЧЕСКИХ БОЛЬНЫХ, ПОДВЕРГНУТЫХ ИНТЕНСИВНОЙ ЛУЧЕВОЙ (ГРУППА 1) И ХИМИОЛУЧЕВОЙ ТЕРАПИИ (ГРУППА 2)



NanoMed

Enterosorption (ES) 3 days before Ir	**Irradiation (Ir) 6 Gy**	ES 10 days after **Ir**

1 group,
Irradiation (Ir)

2 group
Ir + ES

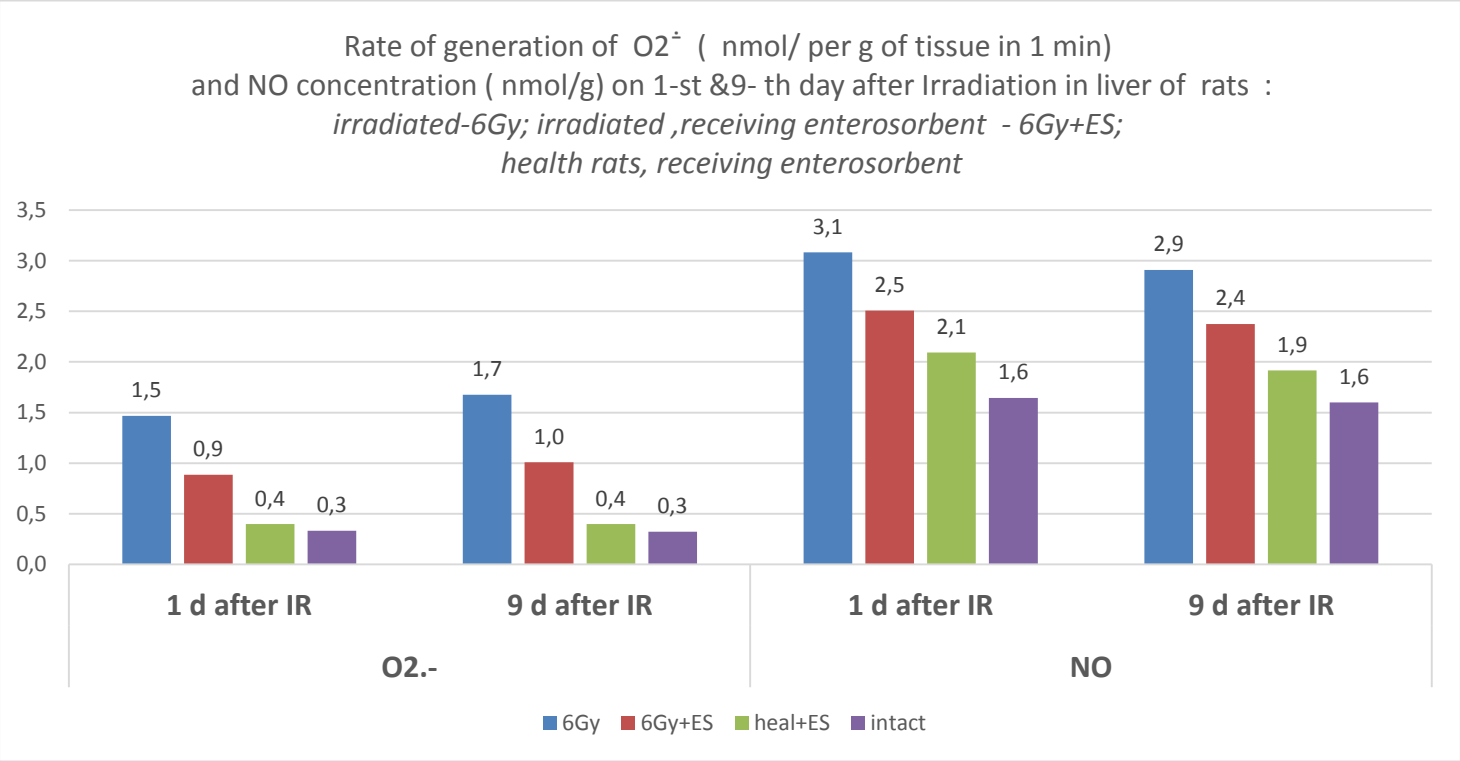
Schema of experiments

3 group
health + ES

4 group
intact

NanoMed

NanoMed



NanoMed

ADSORPTIVE CARBON DRESSING

on the base of activated carbon **fibrous** materials



Use for applicative-adsorptive therapy:

- wounds and burns
- trophic ulcers
- decubitus ulcers
- erosive lesions of mucous of the nasal cavity, mouth, vagina

USEFUL PROPERTIES
OF ACTIVATED FIBROUS MATERIALS





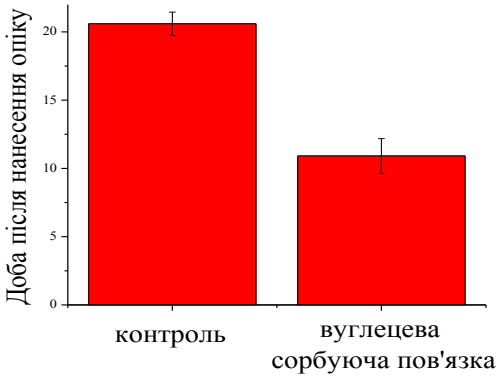
1. Elasticity
2. Hidroscopicity
3. Hemostatic properties
4. Bacteriostatic properties
5. High absorptive and kinetic indices
6. Proteolitic enzymes fixation
7. Ability to fix and release different drugs

Effect of early application of adsorptive carbon dressing (ACD) on the skin structure restoration after the non-full depth thermal burn in rats

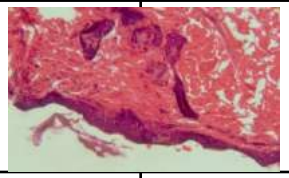
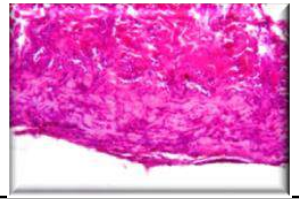
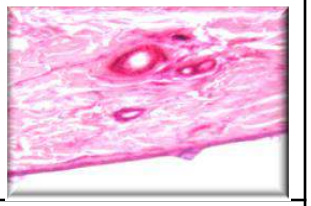
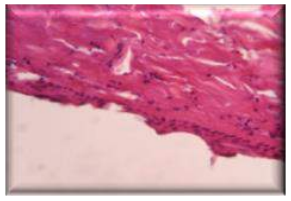
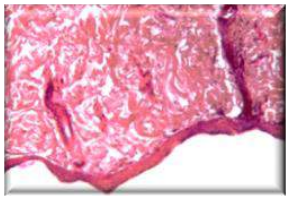


Non-full depth burn of 6.3 ± 0.3 cm^2 square was inflicted on the depilated dorsum of Albino rats by 97±1,5 ^0C water steam. In the first minutes after trauma the burned area was covered with ACD, moistened in cooled solution of chlorhexidine, and thin polyethylene layer to maintain humidity of dressing

The average time of re- epithelialization of burn wounds



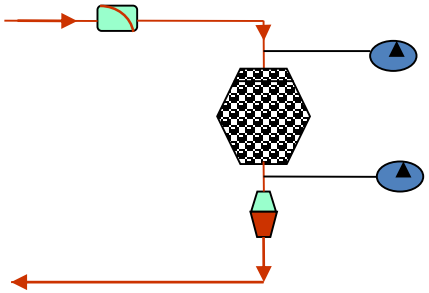
Application of adsorptive carbon dressing creates favorable conditions for the subsequent differentiation of the epidermis on the inherent layers, accelerates skin regeneration in 1.6- 1.9 times

Morphological structure of rat skin		
Group	1st day	7th day
Normal skin		
Thermal burn + gause dressing		
Thermal burn + ACD		

Burned surface had a morphological structure of normal skin in the most part of animals at the 7th day

The promising method to promote the regeneration processes is especially important for treatment of domestic burns in children at the stage of first premedical aid

-Hemoperfusion or Hemosorption
(Plasmaperfusion or plasmasorption)



-Enterosorption



-Adsorptive carbon dressing



Activated carbon
is
perspective and accessible
mean
of prevention , mitigation
and therapy
of damages caused
by Irradiation
exposure


THANK YOU FOR YOUR ATTENTION !!