BY REDUCING ACCUMULATION STRONTIUM IN ANIMALS

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The methods of accelerating the withdrawal of strontium from the body of animals by changing the acid-base balance of the blood and the effect of metabolic acidosis on its intensity. Further experimental acid - alkaline balance change in the direction of metabolic acidosis can be used to accelerate the elimination of strontium poisoned body.

Key words**:** *rat, tissues and organs of animals, strontium, acid-base balance, metabolic acidosis.*

In today's ecological crisis one of the main issues is the environmental pollution with chemicals, including heavy metals [2,6]. With the increase of anthropogenic pollution one of the main priorities in Biochemistry is the study of the peculiarities and mechanisms of action of the most common heavy metals - risk factors for many ecologically dependent diseases. Among the heavy metals that pollute the environment, a special place is occupied by Strontium. Its compounds fall into our bodies with water and food in various concentrations. That’s why there is a risk of poisoning caused by these substances [10].

It is known that recently the number of diseases and injuries of bone tissue has sharply increased. Incidence of vertebral fractures has increased, new types of injuries - traumatic cartilage delamination, fractures in the elbow and knee joints, fractures in children, specific to old age has become more frequent. Particular attention is paid to hidden damage of bone tissue, when the absence of clinical manifestations in it is determined by damage characteristics of bone tissue architecture, acceleration, deceleration and often enhondral ossification, high frequency of local areas of bone dysplasia accumulated. A significant amount of materials about violations of structural and metabolic indicators of bone and

cartilage tissue under the influence of ecologically unfavorable factors in national and foreign literature was compiled [3,4].

Bone and cartilage tissues are the main target for Strontium. Being accumulated in bone tissue it has toxic effects on the osteoblasts changing its structure and mineral composition by replacing Calcium in Hydroxyapatite, which ultimately leads to osteomalacia [3,5].

In most cases, the realization of different effects depends on the concentration of the element. The most metals, when introduced into the body in optimal concentrations can be activators of enzymes, are included to the vitamins, stimulate various biochemical processes that are essential for the normal functioning of a living organism. Deficiency of many elements in water and food can cause serious and difficult phenomena. Intoxication begins with the increase of its optimal physiological concentration in the body [1,2,5,8].

The problem of accumulation and negative impact of heavy metals on animals has led to search the methods of its detoxification in animals organisms and reduce the level of delays in their products, which are obtained in areas contaminated by heavy metals.

The Purpose of the work - to study the effect of experimental metabolic acidosis and alkalosis on the intensity of accumulation and excretion of strontium from the rats poisoned by this metal.

Material and methods of the study. Clinically healthy 3 months old males of white laboratory rats, weighing 150 - 200 g were used for the studies. They were kept in vivarium on a standard diet in cages of 6 . 240 animals were used for experiment. Poisoning of rats was carried out for 14 days by daily intra abdominal injection of Strontium Chloride in a dose of 1/15, with rate of 0.006 g of Strontium Chloride per 0.1 kg. For the modeling of metabolic acidosis and alkalosis states rats from *per os* experimental groups were injected 2% solution of HCl - 4 mg 0.01 per kg of body weight and NaHCO3 - 5 mg per 0.01 kg body weight.

Experimental animals were divided into 5 groups of 8 animals in each group. Experiments were carried out according to the scheme: I - intact rats (control); II -

rats which were injected Strontium Chloride within 14 days; III - rats, which together with Strontium Chloride were injected solution of HCl during 14 days; IV - rats, which were injected with Strontium Chloride and solution of NaHCO3 simultaneously within 14 days; V - rats which were injected Strontium Chloride within 14 days, and after that - a solution of HCl during 20 days. Samples of liver, kidney, heart, bones, muscles and blood of rats were selected for the biochemical studies. [2] Strontium content in the samples was determined with the help of spectrochemical method, using the absorption mode in the air-acetylene flame in AAS-30 atomic and absorption spectrophotometer of “Carl Zeiss” company (Germany). The standard samples of Strontium solution served as control. They were produced at the Institute of Physical Chemistry, Academy of Sciences of Ukraine (Odessa). Indicators of acid-base state: pH, partial pressure of carbon dioxide (P CO2) and oxygen (P O2), bicarbonate concentration [HCO3-], the total carbon dioxide (CO2 total.) and shift of buffer bases (ZBO) in the blood was determined on Blood Gas Analyzer microanalyzer of “Rodelkis” company (Hungary) according to Zihhard-Andersen method. Experiments were conducted in accordance with the Convention of Council of Europe for the protection of vertebrate animals used for scientific purposes. The achieved results were processed statistically using the computer program of MS Excel.

The results of the studies. The problem of accelerating of the withdrawal of heavy metals from the poisoned body was investigated for many years at the Department of Animal Biochemistry, quality and safety of agricultural products named after Hluhuy Academician of NULESU under the guidance of Melnychuk Academician. The research is directed to study the effect of changes of KLS parameter of blood on the intensity of the accumulation of heavy metals in tissues of poisoned animals. The basis of such research is known dependence of the ionization degree of heavy metals on the pH level of environment and intensity of their motion in biological chains under the influence of ionization [2,7,9].

It is known, the internal environment of the body, namely its acid-base status (ABS) plays an important role in metabolism in different physiological conditions

its biological fluids, which in normal circumstances supports dynamic balance between acid and alkaline equivalents in the cell intercellular fluid in blood and other biological fluids. Also ABS is the regulatory and compensatory mechanism that ensures consistency of intracellular and extracellular environment [9]. Acid-base balance is changing and during poisoning by salts of heavy metals, resulting in the body is often coming a metabolic acidosis [2].

Acidosis develops in enhanced muscle activity during aging, ammonia toxicity, as well as various pathologies, including poisoning by heavy metals. There are the following changes in the body: reduced activity of Na + -, K+-ATPase in cell membranes, the concentration of ATP and 2,3- diphosphoglycerate, inhibited the activity of hexokinase and phosphofructokinase in erythrocytes of liver and kidneys. Metabolic acidosis increases the vitamin D-dependent absorption of phosphorus and calcium in the epithelium of the small intestine of rats. It is often associated with primary metabolic disorders such as diabetes, starvation, poisoning and other changes. In addition to the enhanced formation of organic acids cause metabolic acidosis may also be insufficient allocation or neutralization of certain metabolites due to violation of the kidney or intestine [2,7,9].

A considerable amount of heavy metals enters the environment in the form of insoluble and difficult soluble compounds. However, over time, in contact with oxygen and water, the compounds are transformed into soluble forms. This is particularly conducive acidic reaction of surroundings [5,10]. It is noticed that in acid soils the plants receive more than 90 Sr, than with weakly acidic or neutral.This phe nomenon is due to the chemical properties of this element, as most heavy metals in alkaline medium form insoluble hydroxides, thus significantly reducing their mobility. In an acidic environment - on the contrary, most of them ionized, go into soluble in water status, which allows them to move actively in the aquatic environment. This explains the intense accumulation in plants radiostrontium in acidic soils [5]. Studies parameters of acid-base status of blood

of rats poisoned strontium chloride suggest that toxic doses of the metal leads to changes in the relevant parameters (Table).

Acid-base status of blood of rats poisoned strontium chloride, (M ± m, n = 8)

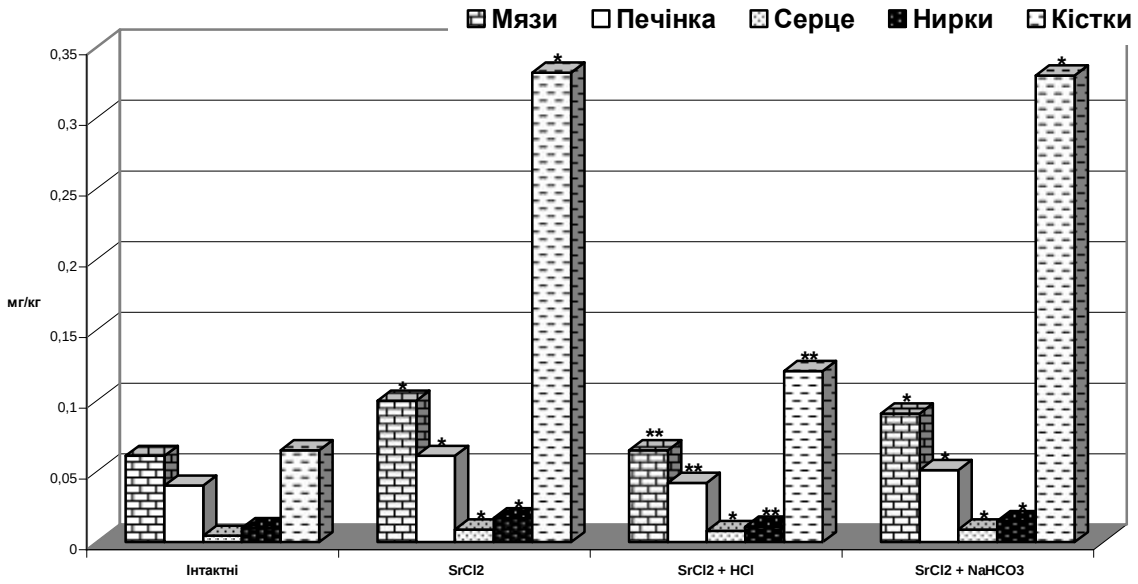
Indicator	Group of rats			
	Cotrol group	Poisoned		
		$SrCl_2$	$SrCl_2$ з HCl	$SrCl_2$,$NaHCO_3$
pH	7,34 ±0,01	7,23 ±0,01	7,12 ±0,01	7,36 ±0,01
p O_2, мм.рт.ст.	53,41±2,47	33,96±2,27*	28,64±2,54*	42,25 ±3,01*
p CO_2, мм.рт.ст.	32,13±1,87	27,25±1,34*	24,34±1,27*	41,24 ±2,49*
CO_2заг., ммоль/л	21,45±1,67	17,28±1,34*	13,11±1,21*	28,12 ±2,72*
[HCO_3^-], ммоль/л	20,33±1,58	16,65±1,43*	12,34±0,98*	27,25 ±1,01*
ЗБО, ммоль/л	-5,76±0,18	-9,20±0,41*	-10,90±0,54*	-4,95 ±0,41*

*** P <0.05, the results compared with values for poisoned animals**

In this case, the pH of blood is shifted to the acid side: from 7.35 in intact rats to 7,23 in poisoning state. These animals have also reduced the level of p CO 2 - By 15.2%, the value of [HCO 3 -] - 18.1%, the content of CO 2 total. - by 30.2%, the value ZBO - by 37.4%, the p O 2 level- by 36.4 %.This pattern of change indicates the occurrence of metabolic acidosis in the body of poisoned animals [14]. These data also indicate that the strontium chloride poisoned animals, which was administered hydrochloric acid, and it is in a experimental metabolic acidosis state.This process is accompanied by a decrease in the pH value to 7.12, total CO 2 content. - by 40.8%, level 2 RDF - by 24.2%, the value of [HCO3 -] - by 39.3%, the value ZBO - by 47.1% and the level of PO2 - by 46.4%.In strontium poisoned rats, which are additionally received sodium bicarbonate normalized rates of acid-base balance, except increase the concentration of bicarbonate by 25.4% and total CO2. - by 27.3%.

Injection of strontium chloride to rats' body on the background solution of hydrochloric acid leads to decrease of plausible accumulation of metals in the studied organs regarding poisonous animals: in 1.6 times in the muscles, in 1.5 times in the liver, in 1.5 in kidney and in 2.7 times in bones (Pig. 1)

There is a tendency to reduce the accumulation of the investigated metal in cardiac muscle. A significant decrease in the accumulation of strontium in the bodies of experimental rats against the background of metabolic acidosis can be associated with an increase in the degree of ionization and the higher the level of solubility of heavy metals in biological fluids. The latter, obviously, contributes intensive excretion of strontium from poisoned animals organs.



Pic. 1. The content of strontium in rats poisoned bodies with changes of acid-base balance of blood, mg / kg (M ± m, n = 8)

*** P <0.05 compared with values for intact animals**
**** P <0.05, likely results compared with values for poisoned animals.**

This assumption is to some extent confirmed by the results of research on a group of animals that were administered both heavy metal and sodium bicarbonate. In this case, the degree of accumulation of strontium in the studied animals bodies practically does not differ from the indicator of poisoned rats. The animals in this group, as already mentioned, the values of blood indicator ABS are similar [2].

Our assumption is also confirmed by the research intensity of the withdrawal of heavy metal poisoned animals after their introduction into the state of experimental metabolic acidosis.

Accumulated data show that the dynamics of research for 20 days is a process of strontium removing from the studied organs of poisoned animals.

However, in animals after poisoning by heavy metals for 20 days received per os with hydrochloric acid (state of metabolic acidosis) the process of its removing was much more intense, which is noticeable already at 4-8 days of research where there is significant difference in the metal content in the studied organs.

Conclusion: The Strontium ions accumulate in the poisoned body, supersed the change of ABS toward acidosis. Their further experimental change in this area can be used to accelerate the elimination of strontium from poisoned body.

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ШЛЯХИ ЗМЕНШЕННЯ НАКОПИЧЕННЯ СТРОНЦІЮ В ОРГАНІЗМІ ТВАРИН

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Розглянуто методи прискорення виведення стронцію з організму тварин зміною кислотно-лужного стану їх крові та вплив метаболічного ацидозу на інтенсивність цих процесів. Доведено, що експериментальна зміна КЛС у бік метаболічного ацидозу може бути використана для прискорення процесу елімінації стронцію з отруєного організму.

Ключові слова: *щури, тканини та органи тварин, стронцій, кислотно-лужний стан, метаболічний ацидоз*

ПУТИ СНИЖЕНИЯ НАКОПЛЕНИЯ СТРОНЦИЯ В ОРГАНИЗМЕ ЖИВОТНЫХ

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Рассмотрены методы ускорения выведения стронция из организма животных изменением кислотно-щелочного состояния их крови и влияние метаболического ацидоза на интенсивность этих процессов. Доказано, что экспериментальное изменение КОС в сторону метаболического ацидоза может быть использовано для ускорения процесса элиминации стронция из отравленного организма.

Ключевые слова: *крысы, ткани и органы животных, стронций, КОР, метаболический ацидоз*