

DYNAMICS OF CELLULAR IMMUNITY BASED ON DIFFERENT DOSES AND EXPOSURE OF ELECTROMAGNETIC RADIATION OF RADIOFREQUENCY RANGE ON THE EXPERIMENTAL ANIMALS

Scientific Research Institute of Sanitary, Hygiene and Occupational Diseases

(Ministry of Health of Republic Uzbekistan, Tashkent)

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Introduction. The scope of electromagnetic contamination of environment has become so significant that the World Health Organization (WHO) included this issue in a number of the global problem the mankind is facing. In the past 10-12 years the quantity of various sources of electromagnetic radiation (EMR) in cities increased and continues to grow quickly. A significant growth of EMR of radio frequency (RF) (mobile, satellite, trunking communication; television and radio stations; radars, etc.) is recorded. A rapid increase of EMR RF sources has led to involvement of great masses of population into activity and passive usage of electromagnetic energy in its different forms; this is associated with night point addition human exceeding to limit level [1-8].

Owing to this, research on EMR RF harm is being actively conducted in the world. Taking into account that in Uzbekistan such research was not carried out till present, although today the vast number of people using mobile and other modern telephones exceeds 20 million apart from other EMR exposure sources, the need to investigate EMR RF effects on different organs and systems of human body is urgent. The immune system is well-known to be one of the most vulnerable homeostatic systems of humans and animals [1] and sensitive to exposure to different physical factors, EMR in particular.

Purpose. To study nature of immune shifts under the influence of EMR RF on the experimental animals and to reveal express criterion of lesions of various organs and tissues.

Materials and methods. The experiment was made on 72 white rats (males) weighing 220-280 g kept on usual nutrition under microclimatic conditions according to the current standards. For the experiment purpose, the rats were divided into 4 groups by 20 in each group and 12 animals composed the control group.

Group I was exposed to 50 mcW/cm² energy flow density (EFD) EMR and 1800 MHz frequency;

Group II was exposed to 500 mcW/cm² EFD EMR and 1800 MHz frequency;

Group III was exposed to 1000 mcW/cm² EFD EMR and 1800 MHz frequency;

Group IV-control kept under the same experimental conditions but with no EMR exposure.

The EMI source was the generator produced by Schwars (Germany), the power amplifier "BLWA1719-20" was produced by "Bonn Electronic" (Germany), the passive antenna "HL 040" was produced by "Rohde & Schwars" (Germany) with auxiliary equipment accessories: cables for power supply, coaxial cable and the support for antenna.

The EMI set exposure was controlled everyday was checked in the State Standard Meters of density of energy flow "PZ-18" (Russia) and "NBM-550" (Germany) with isotropic detectors. The duration of the experiment was 1 month (subacute) and 3 months (chronic). After the each experiment stage, the rats were decapitated. After one-month exposure, 10 animals from every experiment group and 6 animals from the control group were decapitated.

The blood of the animals was taken for analysis, the immunologic tests were made in the Laboratory of Clinical Morphology and Immunology (the head of the laboratory Doctor of Medical Sciences, Professor Gulyamov N. G., the Research Institute for Epidemiology, Microbiology and Infections Disease, MOH RUz).

The dynamics of populations of CD3, T-lymphocyte total pool and B-lymphocyte subpopulation CD4-inducers and CD8- cytotoxic T-lymphocyte in peripheral blood of the experimental animals was determined with calculation of immuno-regulation index (IRI) (ratio of CD4/CD8)

Quantification of the population and subpopulation of lymphocytes was made by indirect rosette formation with monoclonal antibodies produced by the Research Institute for Immunology of the Russian Federation. The reaction was considered positive when the rosettes with three or more erythrocytes were formed.

Results and Discussion. In the course of the research, the changes in the indicators of cellular

Dynamics of cellular immunity indicators in male-rats depending on various EMR exposures (n = 72)

Groups and duration of the exposure	Cellular immunity indicators, M±m				
	CD3%	CD20%	CD4%	CD8%	IRI u.
The first slaughter (after 1- month exposure)					
Control (n=6)	44.2±2.45	19.2±2.45	23.8±1.63	17.0±1.63	1.40±0.13
Group 1 (n=10)	43.3±2.00	19.1±1.67	22.7±2.00	162±1.00	1.40±0.09
Group 2 (n=10)	42.6±2.00	19.8±1.67	20.7±1.67	166±1.00	1.25±0.08
Group 3 (n=10)	41.4±1.33	17.8±0.67	196±1.00•	165±1.33	1.19±0.08
The second slaughter (after 3- month exposure)					
Control (n=6)	45.2±2.45	180±0.82	23.5±1.63	16.8±0.82	1.40±0.04
Group 1 (n=10)	42.3±1.00	18.6±1.67	20.5±1.33	16.2±0.67	1.26±0.10
Group 2 (n=10)	38.1±2.33•	16.9±0.67	17.1±1.33•	15.9±0.67	1.08±0.11•
Group 3 (n=10)	34.4±1.0•*•	15.7±1.33	14.6±1.67•*•	15.1±1.33	0.97±0.13•*

Note: • reliability of the indicator differences compared to the control group; * reliability of the indicator differences compared to group I; • reliability of the indicator differences in slaughters 1 and 2 in the corresponding groups.

immunity in response to EMR exposure were detected (**table**).

The presented findings show that in the animals from the first slaughter exposed to irradiation for one month, the cellular immunity factors have no significant difference from the same indices in the intact animals ($p > 0.05$). However, a tendency to a decrease in the number of T-lymphocytes of the general pool (CD3) and T-lymphocytes inducers (CD4) was evident. B-lymphocytes (CD20) and T-lymphocytes – cytotoxic cells in the first slaughter have changed insignificantly. It corresponds to the data of literature showing that the lymphocyte populations support their level long enough to adapt to the external and internal exposure while T-lymphocytes inducers (CD4) were the most subjected to destruction due to which reduction of general pool T-lymphocytes (CD3) occurs.

The process was accompanied by reliable reduction in CD4 in group 3 with the maximum RF EMR doses ($p < 0.01$). That very reduction of the CD4 levels resulted in a progressive decrease in the immuno-regulation index.

In the animals from group 1, the indicators of cellular immunity practically did not differ from the intact rats, in animals of group 2, and especially group 3, a high dose irradiation brought to a slow but progressive decrease of the test results.

The most significant changes in immunologic indicators were seen in the animals in the second slaughter

in 3-month exposure. In this phase of the experiment, a significant difference almost in all cellular immunity indicators were observed (CD3, CD4, CD8 and IRI) which were registered not only in group 3 animals but in the second group, too ($p < 0.05-0.01$). A decrease in these indicators was observed in the rats in group 1; however, the degree of the decrease was not as significant as in animals in group 3. It should be noted that B-lymphocytes had an evident tendency to a decrease in animals of groups 2 and 3. In the animals from group 1, this indicator, even in long irradiation, practically did not differ from the indicator in the intact animals.

Conclusions.

1. The degree of EMRRF effect on the cellular factors of immunity on the experimental animals considerably depends on the time of exposure and doses of radiation.

2. The most significant changes caused by the exposure were observed in CD4 lymphocytes while the least significant effect was in B-lymphocytes.

3. Depression of cellular immunity rises with an increase in duration of electromagnetic exposure.

Perspectives. Allocation of risk groups depending on the degree of exposure of EMR RF, developing a set of preventive measures aimed at preventing possible violations of the immune system and other organs and body systems, the development of immune diseases.

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ДИНАМІКА ПОКАЗНИКІВ КЛІТИННОГО ІМУНІТЕТУ У ЕКСПЕРИМЕНТАЛЬНИХ ТВАРИН ПРИ ДІЇ ЕЛЕКТРОМАГНІТНОГО ВИПРОМІНЮВАННЯ РАДІОЧАСТОТНОГО ДІАПАЗОНУ

Ташпулатова Г. А., Хамідова Г. М., Ахмедова Х. Ю.

Резюме. Було проведено вивчення клітинного імунітету залежно від потужності і часу дії електромагнітного випромінювання радіочастотного діапазону (ЕМВРЧ) на експериментальних тваринах. Дослідження проведено на 72 білих щурах в 2 етапи (опромінення 1 міс. і 3 міс.). Дози опромінення склали 50мкВт/см², 500мкВт/см², 1000мкВт/см² – 1,2 і 3 групи відповідно (по 10 тварин в кожній групі), і 12 контрольних інтактних тварин (по 6 на кожному етапі). Встановлено, що вплив ЕМВРЧ на клітинні чинники імунітету експериментальних тварин значною мірою визначається не лише тривалістю експозиції, але і потужністю опромінення. Найбільш значні зміни при дії ЕМВРЧ відзначаються з боку CD4 – лімфоцитів, найменш значимо на дію опромінення реагують В-лімфоцити (CD20). Депресія клітинного імунітету наростає по мірі збільшення тривалості електромагнітної дії.

Ключові слова: електромагнітні випромінювання, імунітет, клітинний імунітет, антиген-зв'язуючі лімфоцити, експериментальні тварини.

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ДИНАМИКА ПОКАЗАТЕЛЕЙ КЛЕТЧНОГО ИММУНИТЕТА У ЭКСПЕРИМЕНТАЛЬНЫХ ЖИВОТНЫХ ПРИ ВОЗДЕЙСТВИИ ЭЛЕКТРОМАГНИТНОГО ИЗЛУЧЕНИЯ РАДИОЧАСТОТНОГО ДИАПАЗОНА

Ташпулатова Г. А., Хамидова Г. М., Ахмедова Х. Ю.

Резюме. Было проведено изучение клеточного иммунитета в зависимости от мощности и времени воздействия электромагнитного излучения радиочастотного диапазона (ЭМИРЧ) на экспериментальных животных. Исследование проведено на 72 белых крысах в 2 этапа (облучение 1 мес. и 3 мес.). Дозы облучения составили 50мкВт/см², 500мкВт/см², 1000мкВт/см² – 1,2 и 3 группы соответственно (по 10 животных в каждой группе), и 12 контрольных интактных животных (по 6 на каждом этапе). Установлено, что влияние ЭМИРЧ на клеточные факторы иммунитета экспериментальных животных в значительной степени определяется не только длительностью экспозиции, но и мощностью облучения. Наиболее значительные изменения при воздействии ЭМИРЧ отмечаются со стороны CD4- лимфоцитов, наименее значимо на воздействие облучения реагируют В-лимфоциты (CD20). Депрессия клеточного иммунитета нарастает по мере увеличения продолжительности электромагнитного воздействия.

Ключевые слова: электромагнитные излучения, иммунитет, клеточный иммунитет, антиген-связывающие лимфоциты, экспериментальные животные.

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Dynamics of Cellular Immunity Based on Different Doses and Exposure of Electromagnetic Radiation of Radiofrequency Range on the Experimental Animals

Tashpulatova G., Hamidova G., Ahmedova Kh.

Abstract. The immune system is well-known to be one of the most vulnerable homeostatic systems of humans and animals, and sensitive to exposure to different physical factors, EMR in particular. In this view, the objective of the present research was to study the dynamics and evaluate immunity indicators depending on different doses of RF EMR experimental exposure.

The study was conducted on 72 white rats in 2 stages exposure to 1 month and 3months. Radiation doses were 50mkVt/cm², 500mkVt/cm² 1000mkVt/cm² – on 1st, 2nd and 3rd groups (of 10 animals for each group), respectively and 12 intact control animals (for each 6 stage).

The dynamics of populations of CD3, T-lymphocyte total pool and B-lymphocyte subpopulation CD4-inducers and CD8- cytotoxic T-lymphocyte in peripheral blood of the experimental animals was determined with calculation of immuno-regulation index (IRI) (ratio of CD4/CD8)

The presented findings show that in the animals from the first slaughter exposed to irradiation for one month, the cellular immunity factors have no significant difference from the same indices in the intact animals.

However, a tendency to a decrease in the number of T-lymphocytes of the general pool (CD3) and T-lymphocytes inducers (CD4) was evident. B-lymphocytes (CD20) and T-lymphocytes – cytotoxic cells in the first slaughter have changed insignificantly. It corresponds to the data of literature showing that the lymphocyte populations support their level long enough to adapt to the external and internal exposure while T-lymphocytes inducers (CD4) were the most subjected to destruction due to which reduction of general pool T-lymphocytes (CD3) occurs.

The process was accompanied by reliable reduction in CD4 in group 3 with the maximum RF EMI doses. That very reduction of the CD4 levels resulted in a progressive decrease in the immuno-regulation index. In the animals from group 1, the indicators of cellular immunity practically did not differ from the intact rats, in animals of group 2, and especially group 3, a high dose radiation brought to a slow but progressive decrease of the test results.

The most significant changes in immunologic indicators were seen in the animals in the second slaughter in 3-month exposure. In this phase of the experiment a significant difference almost in all cellular immunity indicators were observed (CD3, CD4, CD8 and IRI) which were registered not only in group 3 animals but in the second group, too.

A decrease in these indicators was observed in the rats in group 1; however, the degree of the decrease was not as significant as in animals in group 3. It should be noted that B-lymphocytes had an evident tendency to a decrease in animals of groups 2 and 3. In the animals from group 1, this indicator, even in long irradiation, practically did not differ from the indicator in the intact animals.

The degree of EMF effect on the cellular factors of immunity on the experimental animals considerably depends on the time of exposure and doses of irradiation.

The most significant changes caused by the exposure were observed in CD4 lymphocytes while the least significant effect was in B-lymphocytes.

Depression of cellular immunity rises with an increase in duration of electromagnetic exposure.

Key words: Electromagnetic radiation, immunity, cellular immunity, antigen- connecting lymphocytes, experimental animals.

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