

Forecasting of the remote radiobiological effects of lens pathology of people taken part in the liquidation of the effects of Chernobol nuclear power station

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ABSTRACT

The research itself reflects the condition of immunological reactivity at lens pathology of people taken part in the liquidation of the effects of Chernobol nuclear power station.

INTRODUCTION

The phenomenon of immune privileges of an eye and its response to damaging action of various factors draws attention of present-day researchers [1,2,3,4].

At ionizing radiation influence the most evident changes occur in the lens as according to many authors it is the most radiosensitive in an organ of vision [5], and also is a classical example of a natural autoantigen [6].

The lens is held away from immune system by blood-ocular barrier (BOB) which operates as an immunologic barrier and interferes with migration of fabric antigens from the eye and to entering of immunocompetent cells into the eye [6].

In case of abnormality of BOB there is formation of autoantibodies to protein of a lens and further development of specific reaction with possible formation of the autoimmune response over 10-14 years [4,7,8].

For formation of the systemic autoimmune response the damage of blood-ocular barrier is not enough. The previous condition of immune system has significant importance.

On this basis the main objective of our work was studying of separate links of immunologic responsiveness of the liquidators of disaster at the Chernobyl Atomic Power Station, with the lens pathology, in the remote period.

MATERIALS AND METHODS

The basic group consisted of 60 men, the liquidators of consequences of the Chernobyl APS (ChAPS), at the age from 40 till 60 years, with a cataract, depending on a year of entrance to a zone of emergency works and the received average radial dose (established by the Medical radiological research center of the Russian Academy of Medical Science, city of Obninsk, on the basis of Russian state medical radiation-measuring register) have been divided into subgroups: I - 1986 – 32 persons, the received dose of radiation – 18.2 ± 0.58 cGy., II - 1987 - 18 persons, the received dose of radiation – 8.43 ± 0.60 cGy and

III-1988 - 1989, the received dose of radiation – 12 persons - 3.27 ± 0.31 cGy. Duration of staying in the zone of heightened radiation hazard is from 5-30 days.

For estimation of contribution of the radiation factor in development of changes of immunologic indicators of the investigated category of persons, the exclusion of influence of a somatic pathology on studied characteristics of leukogram was assumed as necessary. In this connection the control group was formed, in which 60 men were included, of identical age, with a cataract, but not exposed to ionizing radiation influence in the anamnesis. During the investigation done which included estimation of anamnestic, clinical and laboratory data, the immunodepressive diseases connected with effect of radiation or other agents, of persons from control group were not detected.

The healthy group consisted of 60 men of the above-stated age, without lens pathology. In the anamnesis there is no link with ionizing radiation.

Use of mathematical integrated indicators, part from which changes already in the pre-nosological period or at the earliest stages of disease, allows estimating of condition of various links of immune system in dynamics not using special methods of research (4,9). On the basis of results of a peripheral blood we have made mathematical calculation of 6 integrated indicators owing to which we have indirectly estimated condition of various links of immune system of the patients with cataract: Leukocyte Index (LI), Leukocyte Index of Intoxication (LII), Index of Leukocytes Ratio and ESR (ILRESR), Lymphocytic-Granulocytic Index (LGI), Index of Ratio of Neutrophils and Lymphocytes (IRNL), Index of Ratio of Neutrophils and Monocytes (IRNM).

At the bottom of somatic remote consequences (the example: radiation cataract) of post-radiation reduction the inferiority of many regenerative processes was noted, especially it was brightly shown in tissues with low level of physiological regeneration. Exactly the cells of these tissues in consequence of weakly proceeding processes of reparation as though remember radiation influence that happened earlier, owing to what they are easily revealed in experiment [10, 11].

In this connection, we spend studying of stimulated leukocyte agglomeration by antigens of lens in vitro, allowing to estimate the lens condition, in the remote period of influence of ionizing radiation.

Material for research was the lens extract withdrawn during operation of phacoemulsification.

All results are processed statistically by using the program Statistica 6.0.

RESULTS OF THE STUDIES

As is obvious from the data presented in table 1, the Leukocyte Index (LI) reflecting mutual relation of humoral and cellular links of immune system, of the patients from control group was in the range of healthy persons. At the same time, concerning the participants of liquidation on the Chernobyl APS (table 2), the results of the basic group exceeded indicators of control group and healthy persons. The received results give evidence of dysfunction of immune system which is most expressed at the persons who have received doses of ionizing radiation equal to $18,2 \pm 0,58$ cGy.

At calculation of Leukocyte Index of Intoxication (LII) in both investigated groups its increase has been established. In all subgroups of the basic group, LII exceeded the referential limit that is possibly caused by rising of level of an endogenous intoxication.

Index of Leukocytes Ratio and ESR (ILRESR) of the patients with cataract was higher by 42 %

($p < 0,001$) than the results of healthy persons. As to patients with cataract of radiation genesis in the basic group the highest indicators of ILRESR in 1 and 2 subgroups were observed, that allows assuming presence of an autoimmune component in cataract formation.

Table 1. Integral hematological indicators of the persons with cataract (M±m)

Indicator	Groups	
	Healthy (n=60)	Control (n=60)
LI	0,43±0,02	0,51±0,09
LII	0,83±0,07	1,13±0,11*
ILRESR	1,65±0,24	2,84±0,21*
LGI	4,01±0,18	2,55±0,12*
IRNL	2,54±0,11	1,98±0,38
IRNM	17,3±3,42	45,08±3,14*
Note: *- reliability of indicators' difference $p < 0,05$.		

Though, when calculating Lymphocytic and Granulocytic Index (LGI) permitting differentiate autointoxication there was determined its reduction only in the control group for 36,4% ($p < 0,001$) in comparison with the results of healthy persons. In the basic group the LGI indicator was within normal limits regardless of the dose of ionizing radiation.

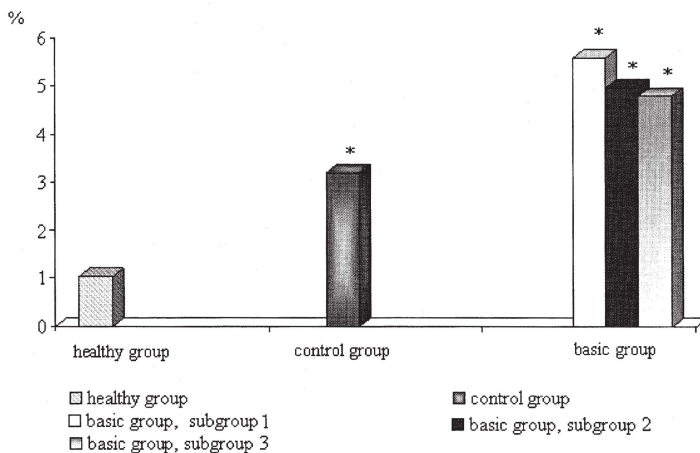
Neutrophil and Lymphocyte Index (NLI) among cataract patients in both groups tended to reduce which is caused by dysfunction of nonspecific resistibility factors. This fact is proved also by results of calculation of Lymphocyte and Monocyte Index (LMI).

Table 2. Integral hematological indicators of cataract patients depending on the dose of ionizing radiation (M±m)

Indicator	Healthy (n=60)	Basic group		
		Group 1 (n=32)	Group 2 (n=18)	Group 3 (n=12)
LI	0,43±0,02	1,28±0,09*	0,58±0,04*	0,56±0,06*
LII	0,83±0,07	1,49±0,09*	1,47±0,11*	1,34±0,08*
ILRESR	1,65±0,24	4,28±0,05*	3,94±0,21*	3,26±0,76*
LGI	4,01±0,18	4,03±0,06	4,19±0,12	3,97±0,22
NLI	2,54±0,11	1,99±0,77	1,74±0,35	1,83±0,41
IRNM	17,3±3,42	47,95±2,1*	49,53±3,15*	48,84±2,18*
Note: *- reliability of indicators' difference $p < 0,05$.				

Further we estimated dose-related stimulated leukocyte agglomeration by lens antigens.

As it seen from the data presented at Figure 1 the stimulation of leukocyte agglomeration by lens antigens was about $1,03 \pm 0,05\%$ among almost healthy people. After statistical analysis it was determined that the indicator exceeding $1,05\%$ is an evidence of increase of adhesion properties of leucocytes to the corresponding stimulator.



* - reliability of differences in regard to healthy group is $p > 0,001$

Fig 1. Leukocyte agglomeration stimulated (%) by lens extract in vitro at cataract

In the control group leukocyte agglomeration indicator was $3,19 \pm 0,52\%$ which is 3,1 times more ($p < 0,001$) than that of healthy group. At the same time there was a clear dependence of leukocyte agglomeration increase from the dose of ionizing radiation among patients with radiation genesis cataract. In this case in subgroup 1 with the dose of ionizing radiation of $18,2 \pm 0,58$ cGy there was determined the highest indicators of stimulated leukocyte agglomeration of $5,59 \pm 1,52\%$ which exceeds the reference limits in 5,4 times ($p < 0,001$). In group 2 this rate was $4,96 \pm 0,73\%$ which is 4,8 times more than that of healthy group ($p < 0,001$). In case of radiation exposure of $3,27 \pm 0,31$ cGy there was determined the least rate of leukocyte agglomeration of $4,79 \pm 0,51\%$. Although these results exceeded the results of healthy group in 4,7 times ($p < 0,001$).

Increase of this indicator is an evidence of increase of adhesive properties of leukocytes to the lens antigens which is expressed clearly in case of cataract among patients who had received different doses of ionizing radiation ranging from $18,2 \pm 0,58$ cGy to $3,27 \pm 0,31$ cGy.

Thus, calculation of integral hematological indicators permitted to determine that regardless of the type of cataract and of the dose of ionizing radiation there forms dysfunction of immune system which leads to decrease of function and metabolic and phagocytic activity of micro- and macrophages, signs of autoimmune component and quality changes of leukocytes in particular increase of their adhesive

properties at this nosology;

It was determined that in case of stimulation of leukocytes with lens extract the indicators of $1,03 \pm 0,05\%$ are referential. Increase of this indicator is a result of increase of adhesive properties of leukocytes.

Leukocyte agglomeration stimulated by lens antigens indicates the level of autosensibilization which is well expressed among patients who had received ionizing radiation of the dose of $18,2 \pm 0,58$ cGy and $3,27 \pm 0,31$ cGy which may be a criterion of dose-related effect for forecasting cataract of radiation genesis.

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