THE FREE RADICAL OXIDATION ORGANISM STUDY IN THE LONG-TERM PERIOD AT THE GAMMA-IRRADIATION AND THE CEMENT DUST COMBINED EXPOSURE IN THE EXPERIMENT

Ilderbayev O.Z., Dalenov E.D.
Semei State Medical University, Semey, Kazakhstan

The final results on the free radical oxidation role at the ionizing radiation and the cement dust combined exposure just in the experiment have been obtained. The diene conjugates (DC) and the malonate dialdehyde (MDA) in the peripheral blood lymphocytes and the lymph nodes, RC in the spleen, the liver, the MDA in the thymus gland and the adrenal glands, the high level content have been revealed.
Keywords: the ionizing radiation, the pneumoconiosis, the free radical oxidation

The leucoses and the malignant tumors beginning are, more often, the delayed radiation actions. It also has been cleared out, that radiation effect upon the human health is able to be depended on the exposure duration: one and the same dose of the ionizing radiation, having received for the short period of time, is being caused the less radiation injuries, than the dose of the ionizing radiation, having received for the prolonged period [1]. The ionizing radiations exposure delayed consequences researches upon the population health are the most urgent and the most actual in Kazakhstan. It is being defined by the fact, that the considerable part of the Republic's territory, first of all, the Semipalatinsk, the Eastern – Kazakhstan, the Pavladar, and the Karaganda Regions have been subjected by the local radioactive deposits and by the local nuclear fallout, as a result of the nuclear tests operation at the Semipalatinsk Testing Area, and the residential population, having lived on all these above – mentioned territories, have also been subjected by, as the internal, well as the external radiations exposure [2]. The biological radiation effect is, usually, consisted in the further atoms' and molecules' ionization and the excitation just in the human organs and the tissues with the subsequent highly radioactive radicals and the peroxides, and also super oxides formation. So, the first 3 phases are, usually, being proceeded at the molecular level just for the negligibly small periods of time, and they are being caused the molecules' chemical changes just in the human organs and the tissues. Thus, all these changes are being transformed, and they are being converted into the subsequent abnormalities just in the cells, in the human organs, and also in the human organism, as a whole, during the 4 – th phase (e.g. the biological one). It goes without saying, the above – indicated processes are being taken their place at the every radiation dose exposure, and they are able to be conditioned not only by the exposure to the radiation, but and the many other non – radiation factors action [3]. In the basis of a number of the pathological states, including the exposure to the radiation, are being connected with the expressed processes initiative of the free radical oxidation [4]. Thus, at present, the non – specific adaptation just at the cellular and at the sub – cellular levels after the radiation damage the urgent system mechanisms have already been studied. For all this, the metabolic processes regulation violation just in the cells is able to be not only the consequence of it, but also, it is the most significant link of the radiation damage pathogenetic mechanisms [5]. The ionizing radiation exposure is being characterized by the CPO processes considerable activation. It has also been determined, that the ionizing radiation is being resulted in the free radicals concentration increase just in the various human organs and the tissues [6, 7]. The last years' investigations have been shown the CP processes important role in the occupational pathology. The workers' respiratory organs occupational pathology, having contacted with the cement dust, has been revealed, mainly,

in the form of the pneumoconioses [8, 9]. But still, there is not the quite enough clear presentation view on the free radical oxidation state changes, in spite of the experimental and the clinical investigations large number, that is being testified on the biological aspects study necessity of the adaptive process, in particular, the immunocompetent organs biochemistry. The ПОЛ is being restricted by the antioxidant protection, the frustration of which is able to be taken its place under the harmful factors and the noxious agents exposures [10].

Its role just in the animals' pathological process formation in the long – term period at the combined exposure is being presented for us much interesting, having taken consideration all this system significance in the further pathological process formation.

The Investigation's Main Purpose: The investigation in the experiment the free radical oxidation role just in the adrenal glands', and in the immunocompetent organs', and the cells' tissues in the long – term period at the gamma – irradiation and the cement dust combined exposure in the experiment.

The Material and the Investigation's Methods: The main experiments have already been made by us for the jointly set target and the assigned task solution at 40 non – pedigreed sexually mature males' albino rats with their 180±20 gr. weight, which, in their turn, have been subdivided into the 3 main groups: the I – st group – the intact ones (e.g. n=10), the II – nd group – the having primed ones by the cement dust (e.g. n=15), and the III – rd group – the having primed + the irradiated ones (e.g. n=15). Thus, the pneumoconiosis has been modeled at the animals just in the II – nd and in the III – rd groups by the E.N. Gorodenskaya methods, in the V.I. Parashina modification [11]. The III – rd group animals have been irradiated during 90 days and nights (e.g. 2,160 hours) just before the investigation at the «Teragam» Co^{60} radiotherapeutic installation. The lipids peroxidation state has been defined just in the various organs and the cells at all the animals. So, the lymphocytes have been singled out just from the peripheral blood, and the homogenates have been prepared just from the liver, the spleen, the thymus gland, the lymph nodes of the small intestine and the adrenal glands, which are needed for the necessary investigation. The diene conjugates (DC) and the malonate dialdehyde (MDA) content has been defined in them by the V.B. Gavrilov, M.E., M.E. Meshkorudnaya (e.g. 1983); S.G. Conyukhova and the other co – authors (1989) method. The investigation's obtained final results have been processed by the variation statistics generally accepted methods with the Student's tests computation.

Investigation's Results and Discussion

As the investigation have been shown, the DC concentration is being increased just in the peripheral blood lymphocytes from 0,29 ± 0,03 up to 1,02 ± 0,12 (e.g. $p<0,001$) and also in the thymus gland from 0,49 ± 0,04 up to 1,76 ± 0,27 (e.g. $p<0,01$) at the cement dust exposure. The DC concentration just in the peripheral blood lymphocytes has been, considerably, and almost in 2,5 times, exceeded the control values (e.g. $p<0,001$) at the animals after the dust and radiation exposure. It has also been registered the reliable lowering in 1,4 time, in comparison with the II – nd group. It has been registered the tendency to the further increase (e.g. $p>0,05$) in the thymus gland, in comparison with the control value. It has also been registered the further lowering in 3,4 times (e.g. $p<0,001$), in comparison with the II – nd group.

So, the animals' DC concentration level, reliably, has not been changed just in the adrenal glands after the dust content, but, at the same time, there is the tendency to the concentration increase from 1,19 ± 0,11 up to 1,45 ± 0,11 (e.g. $p>0,05$), but the considerable changes have not been observed just from the spleen's side, where the DC concentration content level has almost been corresponded to the control values. The DC concentration level just in the spleen has been increased from 1,28 ± 0,20 up to 1,85 ± 0,12, that is, almost in 1,5 time, in comparison with the I – st group index (e.g. $p<0,05$),

whereas the DC concentration level is being lowered from 1,19 ± 0,11 down to 0,57 ± 0,03 (e.g. p<0,001) just in the adrenal glands, at the animals of the III – rd group, having subjected to the combined exposure.

The ПОЛ primary products, as in the liver, well as in the lymph nodes investigation has been shown, that the diene conjugates (DC) content just in the liver has been increased from 0,69 ± 0,05 up to 1,18 ± 0,17 (e.g. p<0,05), and it has been increased from 0,35 ± 0,03 up to 1,09 ± 0,12 (e.g. p<0,001), that is, approximately, in 3 times, (e.g. p<0,001) just in the lymph nodes. The DC concentration level has been increased for 36,7% (e.g. p<0,05), as in the liver, and it has been increased for 55% (e.g. p<0,01), well as in the lymph nodes at the III – rd group animals.

Thus, the obtained final results have been testified on the fact that the free radical oxidation is, constantly, being activated at the dust and radiation and the dust factors exposure, and, it is quite possible, this is connected with the antioxidant enzymes activity lowering just in the studied organs majority.

As, it is quite known, the oxygen active forms excessive generation is lied on the basis of the lipids peroxidation activation. Having exceeded the antioxidant systems physiological capabilities, and having emerged just after the enzyme systems exhaustion, and also all these mechanisms combination, in the case of the radiation factor action, having been determined, on the one hand, by the organism radiosensitive cells massive destruction and the antioxidants loss, and on the other hand – the ПОЛ initiators active generation [12, 13].

The MDA concentration content level has been left at the control values level at the cement dust just in the thin intestine lymph nodes cells exposure, but, at the same time, it has also been observed some kind of the increase tendency just in the lymph nodes cells for 19% (e.g. p>0,05), and in the adrenal glands tissues – for 29% (e.g. p>0,05). The MDA concentration content level has been increased for 53,6% (e.g. p<0,001), and in the adrenal glands tissues – almost in 6,5 times (e.g. p<0,001) at the combined exposure just in the lymph nodes cells, in comparison with the II – nd group, the MDA concentration content level is being increased for 44,5% (e.g. p<0,01) just in the lymph nodes, and it is being increased for 80% (e.g. p<0,001) in the adrenal glands tissues.

The given index concentration content level reliable increase has been registered just in the peripheral blood lymphocytes from 0,072 ± 0,003 up to 0,081 ± 0,003 (e.g. p<0,05) in the II – nd group, up to 0,12 ± 0,01(e.g. p<0,01) in the III – rd group; in the liver tissues from 0,14 ± 0,01 up to 0,19 ± 0,01 (p<0,05) in the II – nd group, so the considerable changes have not been observed in the III – rd group, where the MDA concentration content level has almost been corresponded to the control values; it has been registered the MDA concentration increase content level from 0,031 ± 0,003 up to 0,047±0,004 (e.g. p<0,05) just in the thymus gland tissues in the II – nd group, and it has been increased up to 0,045 ± 0,003 (e.g. p<0,05) in the III – rd group. So, the considerable changes have not been observed by us from the side of the spleen, but, at the same time, the concentration content level index of the III –rd group has, reliably, been lowered, that is from 0,32 ± 0,03 down to 0,22 ± 0,01 (e.g. p<0,05).

The free radical oxidation primary products, having presented just, according to the standard, in the organism in the non – high concentrations, have the physiological effect, which is being consisted in the reversible hydrophilic – hydrophobic transformations of the membrane phospholipids fatty – acid residues and by the bio – membranes functional state change, the membrane – bound enzymes reversible inactivation, that it has been observed by us at the dust factor action just in the spleen's and the adrenal glands' tissues, at the combined exposure in the long – term period just in the spleen's and the adrenal glands' tissues. The free radical

oxidation secondary products have more damaging action that has already been registered just in the peripheral blood lymphocytes and in the lymph nodes', the adrenal glands', and thymus gland's tissues by us.

Conclusions

Thus, the obtained final data have been shown, that the DC and MDA concentration content level is being increased just in the peripheral blood lymphocytes and in the thin intestine, the thymus gland, and the liver lymph nodes cells at the rats at the combined gamma – irradiation and the cement dust exposure through 90 days and nights (e.g. 2,160 hours), which are being corresponded to the long – term consequence periods. So, it is quite possible, the secondary product normalization is being succeeded just in some tissues, owing to the temporal compensatory mechanisms. The investigations continuation, having devoted to the ionizing radiations long – term effects exposure study upon the public health and the arrangements carrying out on the consequences and the long – term effects exposure upon the population elimination are being presented by the most obvious urgency and the most vital actuality.

References

1. Yablokov A.V., "The Atomic Mythology", «The Ecologist's Notes on the Atomic Industry», 1995;

2. Rozenson R.I., «The Respiratory Allergoses Immunopathogenesis Pecularities at the Region's Population, Having Subjected by the Local Nuclear Fallout». – The author's abstract of the dissertational report. – The Special Publications: 1997, p. 34;

3. «The Environmental Radionuclide Contamination and the Population Health». // Under the Editorship of Vasilenko I.Ya., Buldakov L.A. – M., 2004;

4. Moskaljev Yu.A., Streltzova V.N., "The Radiation Damage Long – Term Effects: the Non – Neoplastic Form", (The Science and Technology Resume. "The Radiation Biology" Series, vol. 6). M., 1987.

5. Musagalieva G.M., Uteshev A.B., "The Catecholamines and the Radiation". // Science, Kazakh SSR, 1988. – p. 120;

6. Baraboy V.A., Chebotarjev E.E. // «The Radiobiology». –1986 – № 5. – p.p. 591 – 597;

7. Zhuravljev A.E., «The Bioantioxidants in the Metabolism Regulation in Norm and Pathology». – M.,1982, – p.p. 3 – 36;

8. Rao P.S., Mueller H.S., "Lipid Peroxidation and Acute Myocardial Ischemia", //«Adv. Exp. Med. Biol». – 1993. – 161. – p.p. 347 – 363;

9. Voskresensky O.N., Tumanov V.A., // «The Angioprotectors». – Kiev, 1982. – p.p. 35 – 60;

10. «The Peroxidation and the Radiation». – // Under the Editorship of V.A. Baraboy. – Kiev, 1991;

11. Gadaskina E.D., "The Experimental Pneumoconioses Study Methods". In the book: «The Animals' Diseases Reproduction for the Experimentally – Therapeutic Investigations». L., 1954;

12. Meerson F.Z., Pshennikova M.G., "The Adaptation to the Stress Factor Situations and the Physical Loads". «The Medicine», Moscow, 1988, p. 150;

13. Usenova O., Zhetpisbajev B., Saydakhmetova A., et. al., "The Lipids Peroxidation State Peculiarities in the Long – Term Period after the Fractional Gamma – Irradiation". //«Astana Medicinalyk Zhurnaly». («The Astana Medical Journals»), 2006, № 2, p.p. 114 – 117.