

Perekisnoe Oxidation of Lipids in the Stem Cell Membrane

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Abstract Stem cells are undifferentiated (immature) cells found in many types of multicellular organisms. Stem cells are capable of self-renewal, forming new stem cells, dividing through mitosis and differentiating into specialized cells, that is, turning into cells of various organs and tissues. After injections of stem cells, active division of not only healthy, but also pathological cells of the body begins, including malignant ones, of which the more the older the body. The temporary impulse of youth passes and decline returns, and then various consequences appear. So, if the introduced cells take root, then due to the contradiction with the cells of the body and the immune system, they themselves often degenerate into cancerous ones. In any case, this is a stressful effect on immunity, against the background of which pathology can be realized.

Keywords Peroxidation, Lipoperoxides, Metabolic products, Intracellular metabolism, Norepinephrine, Biomembrane

1. Introduction

Among all cells of the body, the stem cell is truly unique, capable of creating all kinds of cells in the body. The intracellular metabolism of a stem cell can be compared to a reactive nuclear power plant. As a result of rapid division, stem cells use 15% of the energy generated by all other cells. If we put together all the cells formed as a result of the division of one stem cell, their weight will exceed the normal weight of the human body, and the energy expended on one stem cell will be equal to the energy required to lift 100 kg of cargo to the 120-floor. [1]

The discovery of stem cells (SC) is considered one of the most important achievements of mankind. He is put on a par with such grandiose events in science as the decoding of the human genome and the discovery of a double-stranded DNA strand. The ability of any SC to produce different cell types makes them a very convenient system for studying molecular genetic events that cause cell differentiation. Due to their ability to differentiate into any tissue, SCs can be used to treat a wide variety of diseases. Therefore, a comprehensive study of the SC is one of the urgent and promising areas of modern medicine. [2]

However, there are some factors that negatively affect the normal functioning of stem cells and change their structure. The blood supply in the bone marrow is significantly lower in comparison with the metabolism occurring in it. The consequence of this imbalance can be a violation of microcirculation in the bone marrow and intracellular

homeostasis of stem cells. Insufficient oxygen supply to the stem cell leads to a change in pH, disruption of redox processes and the formation of imperfect stem cells. [3]

At present, the formation and excess yield of lipid peroxidation products under pathological conditions, which damage the phospholipids of the cell membrane, have been proven. The most important link in stress cell damage is the activation of the peroxidation of polyene phospholipids of the cell membrane. As you know, in stressful situations, norepinephrine and its metabolic products are excessively produced, which have a strong pro-purifying effect. Activation of lipid peroxidation occurs under the influence of biogenic amines and leads to disorganization of the structure of the cell membrane. [9] Lipid peroxidation reactions are free radical and constantly occur in the body. Free radical oxidation disrupts the structure of many molecules. Some amino acids are oxidized in proteins. As a result, the structure of proteins is destroyed, and covalent "crosslinks" are formed between them. This activates proteolytic enzymes in the cell that hydrolyze damaged proteins. Reactive oxygen species easily disrupt DNA structure. [4]

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Serotonin, the concentration of which increases by 1.5-2 times during stress, inhibits lipid peroxidation and has a compensatory membrane stabilizing effect. An example of the intensification of lipid peroxidation processes under pathological conditions can be the mechanism of the effect of radiation and ionizing rays on the body. As a result of increased peroxidation of unsaturated fatty acids, free radicals, lipoperoxides, ketones, aldehydes, and other toxic products are formed, which accumulate in the bone marrow and have a negative effect on it. Intense lipid peroxidation of the biomembrane, in turn, leads to a modification of the stem cell DNA structure. dysfunction of cells. [5]

When lipid peroxidation is stimulated, a secondary violation of the DNA structure is observed. This effect depends on the concentration of peroxides. Stem cells also contain defense systems: natural antioxidants (vitamin E, vitamin K, glutathione), enzyme systems that protect the body from oxidation of free radicals (superoxide dismutase), fats that stabilize and strengthen the cell membrane: tocopherols, ubiquinones, phylloquinones. These substances reduce the concentration of free radicals as a result of the rupture of the hydroperoxide link. Thus, the rate of lipid peroxidation is regulated by several systems that provide functional stabilization of stem cells. [6,10]

Violation of the DNA structure of any cell leads to irreparable gene modifications. Recently, genes that regulate cell apoptosis have been deeply studied. The BCL2 and C-FES genes located on chromosome 18 inhibit the apoptosis function, while the BAX, BAK, BAP, P-53, APO-1 / FAS genes stimulate. The reason for the suppression of apoptosis is the mutation of the R-53 gene, which from the state of the inductor goes into the state of the inhibitor of apoptosis. [7,8]

Neural stem cells, which also belong to the tissue-specific group, are being investigated separately. They differentiate during the development of the embryo and during the fetal period, resulting in the formation of all the nervous structures of the future adult organism, including the central and peripheral nervous systems. These cells were also found in

the central nervous system of an adult organism, in particular, in the subependymal zone, in the hippocampus, olfactory brain, etc. Despite the fact that most of the dead neurons are not replaced, the process of neurogenesis in the adult central nervous system is still possible due to neural stem cells, that is, the population of neurons can "recover", but this occurs in such a volume that it does not significantly affect the outcomes of pathological processes.

2. Conclusions

Thus, the imbalance between the blood supply to the bone marrow and the accelerated metabolism of stem cells triggers a cascade mechanism, the end result of which is the disruption of the DNA structure of stem cells. This, in turn, leads to mutation of genes that provide cellular apoptosis. Inhibition of apoptosis leads to excessive proliferation, impaired differentiation and cell atypism.

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