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STRUCTURAL CHANGES IN OSSEOUS AND CARTILAGINOUS TISSUES OF THE MANDIBLE UNDER EFFECTS OF HEAVY METALS SALTS ON THE BODY

Abstract. *We have studied morphological changes in the osseous and cartilaginous tissue of the lower jaw of 72 experimental male albino rats whose bodies were influenced by the salts of heavy metals. We used anatomical, osteometric, spectrophotometric, histological, histochemical, morphometric, immunomorphological and statistical methods. It is shown that heavy metals salts cause the development of deep and persistent structural changes in the osseous and cartilaginous tissues of the mandible, which is accompanied by inhibition of growth, development of resorptive processes in the osseous tissue, reduced mineralization, depletion of inorganic matrix in macro- and microelements. Negative morphological changes develop in the process cartilage: zonal structure is impaired, proliferative activity of chondrocytes is inhibited.*
Key words: *osseous tissue, mandible, heavy metals salts.*

Introduction. Due to the intensification of chemical and mining industries, the environmental pollution increased and the antropogenic impact of chemical xenobiotics, including salts of heavy metals (SHM) on the human body and a damage of different organs and systems have grown [1,2]. Hygienic, Epidemiological and clinical studies have shown that heavy metals play a vital role in the occurrence of many diseases of the human body [7]. However, the features of the reaction of the dental system hard tissues under the effects of SHM on the body have not been studied sufficiently, even though it is shown that amalogenesis gets impaired under the influence of SHM as well as the incidence of dental caries in the areas, where the content of these chemical pollutants in the environment is increased, grow [5,6]. However, the literature does not give a detailed analysis of structural changes in the dentin under the influence of SHM [8].

Objective: to establish the features of structural changes in osseous and cartilaginous tissues of the mandible under the effects of heavy metals salts on the body.

Materials and methods. The study was conducted on 72 laboratory mature male albino rats in accordance with regulations adopted by the European Convention for the Protection of vertebrate animals used for scientific purposes (Strasbourg, 1986) and the Law of Ukraine "On protection of animals against cruelty» № 3477-IV of 21.02 .2006. The rats of the control and experimental groups were on a standard diet. The experimental animals received a combination of heavy metals found in excessive amounts in the northern Sumy region (increased amounts of zinc, copper, iron, manganese, lead, chromium). We used the anatomical, osteometric, spectrophotometric, histological, histochemical, morphometric, immunomorpho-

logical and statistical methods.

Results and discussion. In case of the SHM impact on the body, there is an inhibition of growth processes in the mandible and its formation. Lagging in osteometric indices of experimental animals compared to the intact rats remained at 5.02% - 8.58% (p <0.05).

At the microscopic level in the tissues of the lower jaw of experimental animals we observed changes of the structure, inhibiting proliferative activity of chondrocytes, which sometimes disappeared completely, atrophied or segregated in separate isogenic groups with very low proliferative activity. The number of cells reduced dramatically: they were irregularly shaped, the contours of chondrocytes were destroyed in some places, mitosis figures were hardly observed. The cells were mostly polygonal, there was a great number of layers of connective tissue and debris of damaged cells around them. The total width of the cartilage reduced by 4,89% (p <0,05).

There were signs of appositional growth inhibition in the compact substance as well as slower transformation of the membrane reticulated and osteoid osseous tissue into a splenial one. The ossification of intermediate osseous substance got impaired. The deformed and altered lines of adhesion, mosaic areas of calcification became clear. We marked disorders and inhibition of formation of secondary osteons, and, in contrast, an increased number of primary osteons, as evidenced by a decrease in their diameter and increased width of haversian spaces. The resorption cavities appeared.

In our view, the suppression of protein synthesis function by osteogenetic cells plays a significant role in the mechanism of development of deep regressive morphological changes in the osseous and cartilaginous tissues of the mandible influenced by SHM. It is confirmed by the low expression of group S100 proteins, since these proteins are actively involved in shaping the osseous tissue by mineralization of cartilage due to their ability to bind to calcium ions [3]. By forming both homo- and heterodimers, S100 proteins form complexes with proteins Ca2 + and Zn2 +. Entrapping these ions can change the spatial organization of S100 protein and provides connectivity to various proteins - targets and enhance their biological action [4]. Thus, by reducing the expression of calcium in the binding protein S100 in the osteogenetic cells the mineralization of the osseous tissue gets impaired and regressive morphological changes develop in it.

The results of chemical analysis of the osseous tissue showed that a reduction of calcium ions and basic osteotropic microelement zinc, which are forced out of hydroxyapatite crystals by cations of heavy metals due to their accumulation are observed in the crystal lattice of hydroxyapatite. It causes a depletion of bone inorganic substances. After a month of heavy metals impact on animals, we found deep disturbances in macro- and microelement composition of the lower jaw and the incisor. Changes in the chemical composition of the experimental organs reach significant values - 15,32% – 17,49% (p <0,01).

Thus, the intake of excessive SHM (chromium, manganese, iron, zinc, copper and lead) results in disturbances of the chemical composition of mineral component of the mandible and trace element metabolism in the experimental dentition organ, resulting in profound morphological changes in the crystal lattice. This, in turn, manifests itself by growth inhibition, deffects in the structure and shaping of the lower jaw and the incisor.

Conclusions. Organometric and histomorphometrical indicators, the chemical composition of the lower jaw under the effect of heavy metals on the body demonstrate the development of deep and persistent structural changes in the osseous and cartilaginous tissues. We observe inhibition of growth, development of resorptive processes in the tissue, reducing mineralization, depletion of inorganic matrix of macro- and microelements. Negative morphological changes develop in the process cartilage: zonal structure is impaired, proliferative activity of chondrocytes is inhibited, the width of the cartilage and some of its zones reduces by 4.80% -9.77% (p <0.05).

Prospects for further research. Considering

the proposed mechanism of the development of changes in the osseous tissue under the influence of SHM to study the ways of correction of changes in the bone tissue.

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