MORPHOLOGICAL CHANGES IN ELEMENTS OF THE KNEE JOINT UNDER THE INFLUENCE OF EXPERIMENTAL HYPOTHYROSIS

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Abstract. *A decrease in the activity of the thyroid gland, or rather the presence of thyroid harmonization in a low blood concentration, leads to the fact that the metabolism in the body gets out of control, as a result of which pathological changes develop to some extent. Its hypofunction occurs due to several factors: iron injuries, tumor and cystic diseases, neurosalts of the pituitary-hypothalamic system, defects in iron development, surgical errors, long-term use of thyreostatics, etc. The situation with hypothyroidism is one of the most common among the population, iodine deficiency is among the regional ones for our country.*

This article describes the morphological and morphometric changes in the elements of the knee joint in early ontogenesis in the generation of mothers caused by experimental hypothyroidism during pregnancy. The model of experimental hypothyroidism and the results of the study allow early detection of morphofunctional changes in the elements of the knee joint in generations born from this disease

Keywords: *experimental; subchondral; thyrotropin; metaphysis; chondrocyte; hypothyroidism; triiodothyronine; thyroxine; synovial; knee joint: morphological; musculoskeletal; tendon; deformity.*

Relevance. Throughout the world, thyroid diseases occupy one of the leading places in the pathology of endocrine organs. The need to study the subtle mechanisms of the pathogenesis of this disease, which is accompanied by disorders of all types of metabolism, is explained by the fact that replacement therapy, which is used in the treatment of hypothyroidism, does not fully ensure the necessary balance of thyroid hormones.

Hypothyroidism directly affects the activity of almost all organs and systems. In applied medicine, there are cases of detachment of joints from the bone, in places of their fixation, but this cannot be associated with the development of osteoporosis due to functional overload of the musculoskeletal system.

In our opinion, the entire complex of tissues of osteochondral joints reacts to the influence of loading conditions with a set of reactions of both a plastic and resorption nature, and tissue relationships change at the places of attachment of the joints. However, the adequacy of such a response occurs inside the bone of both the organ and the entire organism as a whole, and also depends not only on the potential phylogenetic capabilities of the paraarticular system of the tissue complex, but also on other factors: loading conditions, metabolic changes against the background of hormonal imbalance, as well as age characteristics [3,5, 6, 8].

At the same time, studies of the functional anatomy of the musculoskeletal system of the free part of the foot have not established a sufficiently clear relationship between the anatomical,

morphometric, histological and biomechanical features of the knee joint, which determine the selectivity of deformities of the musculoskeletal system and their complexity [4, 7].

The lack of data on the morphofunctional properties of the musculoskeletal system of the free part of the foot leads to serious shortcomings and errors in the prevention and treatment of injuries and deformities in this area. Thus, solving these issues is not only a scientific, but also a practically significant problem.

Despite existing evidence of fundamental changes in this direction, many aspects of this problem have not yet been fully disclosed. Thus, data on the functional anatomy of the musculoskeletal system and adhesive processes of the knee joint are very little studied and contradictory; in addition, there is no data on changes in the micromorphology of the ligaments and their structures, as well as the biomechanical mechanisms underlying the high adaptive plasticity of the joint. The complex of elements of the knee joint has not been fully studied.

However, assessing the indicated morphological characteristics of this system in the area of large joints may be important in determining the location of its least stability, the risk of injury at different age periods, and the biomechanics of injury, which is of great importance for revealing the nature of desmopathies, enthesopathies and tendonitis of various origins.

All of the above allows us to conclude that this problem is poorly studied, which is associated with deformation and damage to the limbs and the lack of their morphofunctional justification.

Purpose of the study.To study the morphological formation of the knee joint, mineral metabolism and the structural and functional state of the musculoskeletal system depending on the decrease in the functional activity of the thyroid gland.

Materials and methods. During the experiment, the rules of regulations for conducting experiments on animals were fully observed in accordance with the “World Convention for the Protection of Vertebrate Animals” (1997), on the basis of which the rats were placed in special metal cages in a vivarium, with no more than 5 animals in each. The experiments were carried out in the spring-autumn period. Each animal was fed within the established standard feeding ration. Sexually mature rats with established pregnancy were kept in a separate cage from the 16th to the 18th day of pregnancy. For morphological studies, animals were decapitated under chloroform-ether anesthesia.

Samples measuring 4-5 mm were separated from the ligaments, and pieces measuring 5-8 mm were separated from the bone-tendon joints. The material was fixed in a 5% solution of neutral formalin. Samples of decalcified bone tissue compounds were treated for 36 hours in a 5% nitric acid solution followed by the addition of a 5% carnua solution. During the day, samples of bone-tendon joints were washed in running water and dehydrated in high concentration alcohols: 50, 70, 96, 100% and embedded in wax paraffin. Incisions 8-10 microns thick were made from paraffin blocks in a universal microtome. Sections were stained with xylene, hematoxylin, eosin, and Van Gieson. Morphometry of the structures was carried out under an MBI-15 microscope.

Elements of the animals' knee joints were isolated for histological examination. Bone tissue samples were fixed in a 10% formalin solution and then in paraffin. A histological section 10 μm thick was prepared and stained with Schick's histochemical reaction with hematoxylin-eosin, Van Gieson, Masson, and picrofoxin.

Research results. Experimental materials from elements of the knee joint of rats in the control group, in which experimental hypothyroidism was induced, were subjected to morphological examination.

We identified two types of connective tissue in rats: dense, regularly shaped connective tissue (Figure 1); which are located at the junction of the fibrous-articular sutures and their passage through the articular angles (Fig. 2).

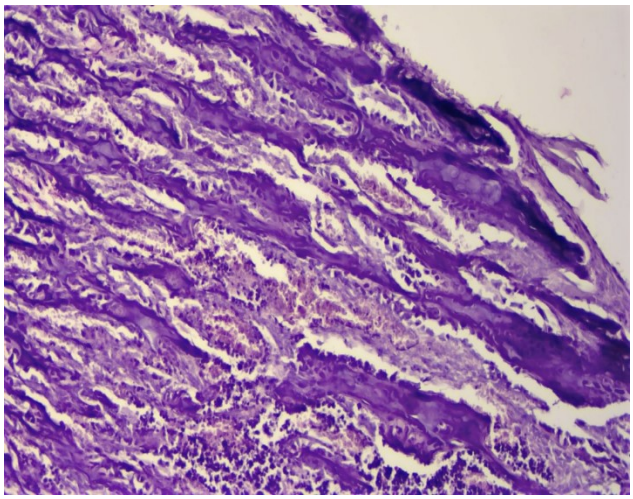

Figure 1. The bursa of the knee joint is a densely formed connective tissue. Van Gieson staining. 10.10.

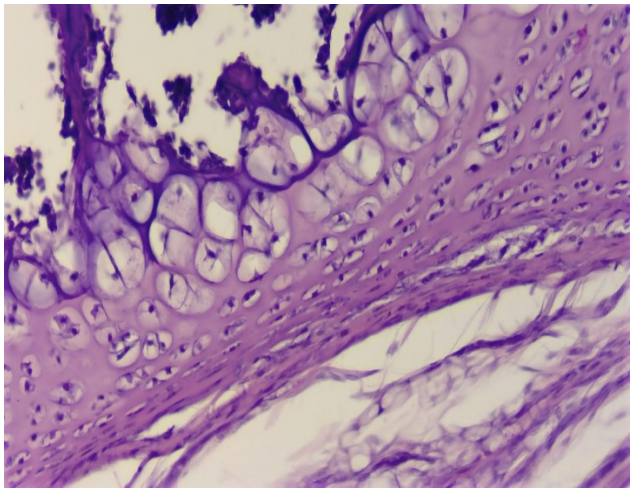

Figure 2. Fibrous connective tissue of the joint ligament. Hematoxylin and eosin staining. 10.

The distribution of cellular elements in tendon tissue is unique. The dominant cell populations are fibroblasts, and their representatives are localized in the thickness of collagen fibers and in the loose connective tissue of endo- and peritenonumia (Fig. 3). Of these, fibrocytes predominate quantitatively; they are characterized by an elongated nuclear shape and depleted cytoplasm

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A histological examination carried out in all animals of the control group revealed an articular capsule consisting of fibrous connective tissue. The synovial membrane is fibrous, and in some areas there are short papillae. Collagen fibers consist of tightly adjacent fibers.

The knee joint is formed on the surface by chondrocytes arranged perpendicular to the columns. Deeper than the newly formed cartilage tissue, longitudinal nests lie, while on the superficial parts young cartilage tissue with basophilic nuclei is visible. The knee joint is surrounded by a capsule of dense connective tissue.

In the field of metaphysics, a zone of well-colored cellular elements is defined. Osteoblasts and new bone columns forming are located along the edges. Slight basophilia of the main substance of the cartilage tissue was found in the hyaline cartilage of the knee joint.

Their long axis is directed along the collagen fibers. At the same time, the presence of young cells was also revealed: young and mature fibroblasts, a round-oval nucleus and a large volume of cytoplasm. These cells are usually localized on the superficial layers of tendon tissue and are located in groups that are arranged in the form of chains. Glycogen is found in the deep layers of tissue, which, apparently, are the initial product in the synthesis of chondroitin sulfate, which depends on the intensity of the metabolic process in these zones.

The detection of mucopolysaccharides in the deepest zones is explained by the fact that the diffusion of nutrients occurs mainly in these zones. The high content of components immediately near the cell indicates the synthesis of mucopolysochorides in chondrocytes. The location of the detected substances corresponds mainly to the distribution of mucopolysochorides in the knee joint, tendons of the articular fossa, as well as in bone tissue.

In experimental animals, pathomorphological changes in the elements of the knee joint with hypothyroidism showed incomplete development of collagen fibers of the fibrous capsule and homogenization of these fibers. Among the fibrous structures, the formation of the joint space, which was narrow, is important. The synovial membrane is papillary, thinned and convex areas of collagen fibers are revealed. The knee joint consists of well-unstained chondrocytes, homogenized incomplete underdeveloped tubular tissue. In cartilage cells, nuclear hypochromia is observed, and in some areas there are signs of necrobiosis and necrosis. The areas of attachment of the fibrous structures of the knee joint with sparse fibrous tissue are visible (Fig. 3).

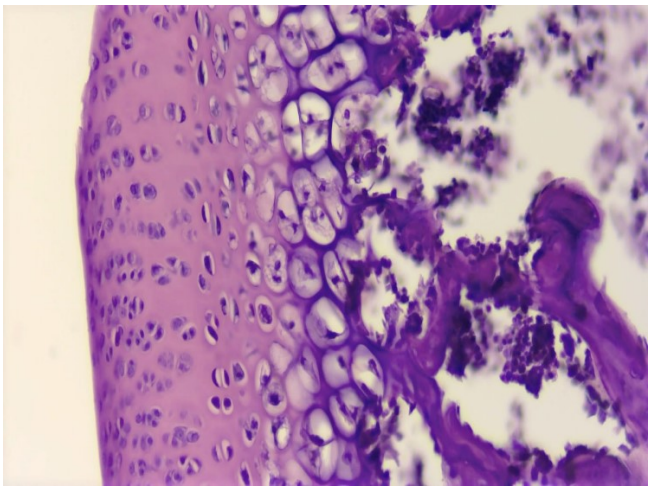

Figure 3. Destructive transformation of the epiphyseal cartilage. Hemotoxylin-eosin staining. 10.10.

Degenerative-dystrophic changes in the knee joint are clearly identified. Most of the cytoplasm of hyaline cartilage chondrocytes is highly vacuolated, necrobiosis and necrosis of chondrocytes are clearly visible. In the metaphyseal zone, newly formed individual bone columns and cavities filled with fatty bone marrow are revealed. Consequently, the description of the detected changes indicates the development of dysplasia in the knee joint.

Histochemical tests have shown that in hypothyroidism there is a significant weakening of the metachromasia reaction in the subchondral zone of the knee joint and the hyaline cartilage of the glenoid fossa, and at the same time there is a slight increase in CHIC-positive substances.

Changes in the synovium are characterized by diffuse detection of mucoid substances both in the underlying substance and in the cytoplasm of fibroblasts. This manifests itself in the form of a pronounced CHIC reaction in the fibrous layer of the capsule, as well as granular inclusions in the integumentary cells.

A significant weakening of all reactions to acidic mucopolysaccharides in the subchondral layer of the knee joint indicates profound physicochemical changes in all parts of the joints.

Conclusion. Interpretation of morphological, histochemical, and laboratory data obtained during the study made it possible to establish the concept of the influence of hypothyroidism as a risk factor for the development of deformities of the knee joints.

Histological and histochemical changes found in the elements of the knee joint may indicate serious disturbances in the formation of these components of the joint and provoke the development of dysplasia. Consequently, changes in the components of the knee joint are more negatively expressed in hypothyroidism, which can lead to incomplete development of the joint.

The knee joint has been morphologically studied by few researchers. At the same time, data on the state of the cartilage tissue of the knee joint is important from the point of view of its ability to transform and regenerate after straightening the knee joint.

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