Age-related morphofunctional features of changes in the thymus gland of experimental animals under the influence of genetically modified product

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Abstract: *The thymus is the central organ of the immune system. In the early stages of ontogenesis, it controls and directs the structural and functional maturation of immunocompetent tissue, and in the later stages, it ensures the safety and expediency of immunological reactions [3,8]. The thymus is a lymph-epithelial organ, its parenchyma is represented by a three-dimensional network of epithelial cells, the processes of which are connected by desmosomal contacts and form a kind of syncytium [3,5].*

Key words: immune system, mesenchymal origin, T-lymphocytes, experimental animals, biological safety.

Introduction

The gaps between the epithelial cells are filled with cells of the lymphoid series, mainly T-lymphocytes, which are at different stages of differentiation. They make up up to 90% of all thymus cells [2,9]. In addition, there are many cells of mesenchymal origin, primarily macrophages and interdigitating cells. The ratio of lymphocytes and non-lymphoid cells in the thymus cortex is approximately 100:1, in the medulla - 1:20 [10]. The medulla is also distinguished by the presence of thymic bodies (Gassal bodies), which are formed by concentric layers of epithelial cells. The histogenesis of the thymus is complex. It is the thymus that is central to the formation (in functional and morphological terms) of the system of immunogenesis and the launch of the immune response in pathology [1,2]. In this regard, it is undeniable that the thymus is one of the most important central immune organs that regulate the body's defense resources in response to the ingestion of various types of antigens, and, in particular, gene-modified products [7,11]. However, despite significant advances in the study of the structure and function of the thymus in humans and experimental animals, there is still no data in the literature on the regularities of its morphogenesis after the use of GMOs. Such data are extremely necessary for understanding the general patterns of integrated action of all parts of the immune system after the use of GMOs [4,6]. The new data will provide a morphological basis for justifying the tactics of immunocorrecting and immunomodulating therapeutic measures for various immunodeficiency states of the body. In addition, they will help to establish morphological criteria for the reserve capabilities of the immune system at the organ and system levels. Meanwhile, the question of the regularities of morphological changes and cytodynamics in the thymus under the action of modern GMOs is poorly covered in the literature. It was most often considered in various pathological conditions of the thymus [1,8]. Therefore, it is possible to judge the structural changes of the thymus only indirectly from the data on the morphogenesis of the thymus in pathology and the immune response to other antigens

Thus, there is no data in the literature on the regularities of changes in the structure and cytoarchitectonics in different zones of the thymus in response to the action of genetically modified organisms. Literature data on the morphogenesis of the thymus under the action of GMOs are absent or not sufficient. Given that in recent years, GMOs have started to be used everywhere, it is not difficult to understand what danger they can pose to humans.

Material and Methods. The study was conducted on 60 mongrel rats; newborns, 1 and 3 months of age. All animals were kept in the same conditions of the vivarium. The rats of both the control and experimental groups received the same daily diet. All laboratory animals were divided into 3 groups: the experimental group-animals that included soy flour in the general-purpose diet (at a dose of 0.02-0.03 g per 1 rat weighing 130-150 g for 30 days (n=20); the control group - animals that received only a general-purpose diet, without soy flour (n=20). The 3rd group-intact animals (n=20). Soy was used as a GM product in the experiments. Using the PCR method, the presence of the 35S+FMV promoter in the studied GM soy was revealed.

After 30 days of feeding soy flour, groups of laboratory animals were killed in a humane way, then an autopsy was performed. When killing and dissecting laboratory animals, the rules of biological safety and ethical principles of working with laboratory animals were observed.

To study the morphological parameters of the thymus, a macroscopic method (anatomical dissection) was used. After cutting, the material was fixed in 10% buffered formalin, then washed in water and dehydrated in alcohols and compacted with benzene. After that, they were poured into paraffin and prepared sections with a thickness of 4-6 microns, which were stained with hematoxylin and eosin. The sections were examined morphometrically, using an eyepiece micrometer DN-107T / Model CM001 CYAN cope (Belgium).

Results and Discussion

The results of the study show that in newborn rat pups, the thymus gland in 57.4% of cases consisted of 2 lobes and in 42.6% of one, multi-lobe forms were not detected.

Under the action of GMOs, we did not detect any noticeable changes in the anatomical parameters. The most pronounced changes are observed in the microscopic structure of the thymus gland.

The experiment was accompanied by a decrease in the thickness of the capsule and the trabecula of the organ in all the studied age periods. GMO exposure in mature rats results in a 16.8% reduction in capsule thickness. With an increase in the duration of the experiment, there is a more intense decrease in the thickness of the thymus trabecula and by the first month it decreases by 30.4%, and in 3-month-olds-by 27% compared to the control group. As for the changes in the capsule and trabecula in the age aspect in the experiment, the most intense increase in the thickness of the capsule is observed before the age of one month – by 1.2 times. In the experimental group of rats, the process of differentiation of the connective tissue skeleton into layers slows down and, if in the control group of animals, their onset is detected by 1 month, then in the experiment-by 3 months of age.

The experiment is accompanied by a decrease in the distance between the fibrous structures of the connective tissue. They are located more densely, the thickness of the bundles of collagen fibers decreases. The degree of tortuosity of elastic and reticular fibers increases

In the experiment, the thymus parenchyma does not have a distinct division into cortical and medullary matter, and there is also an increase in the small and large diameters of the medullary matter compared to the control.

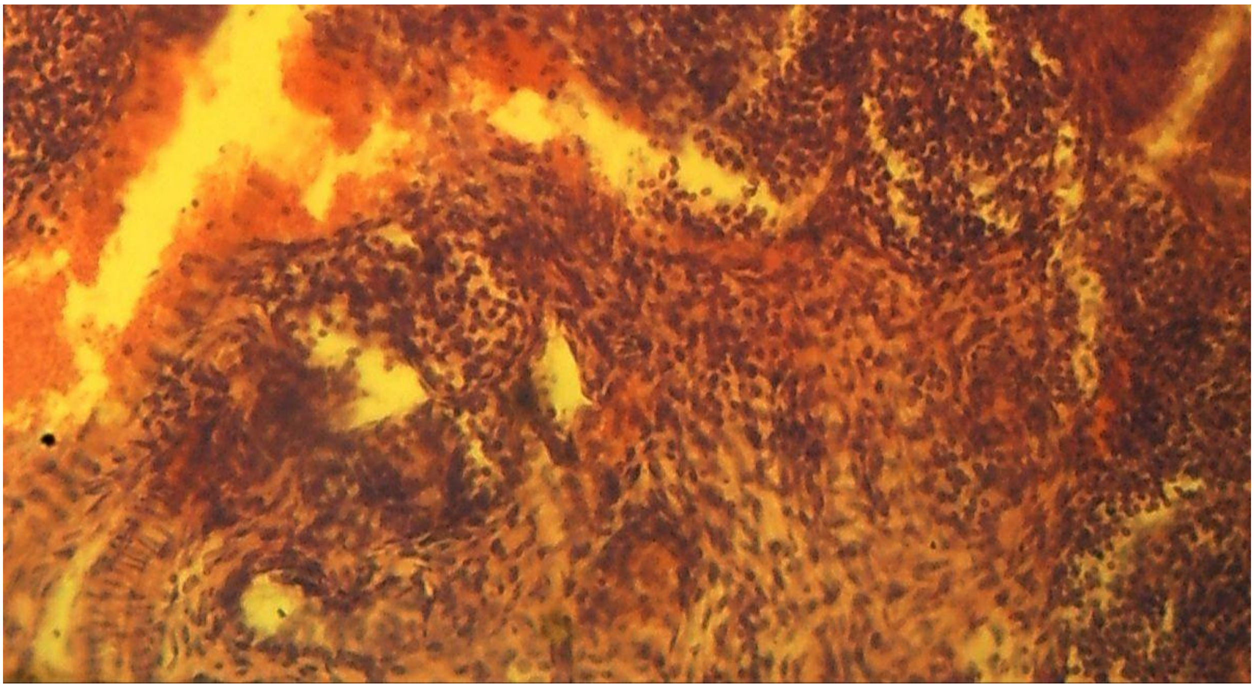

Fig.1. A thymus lobule with a limited connective septum, and numerous blood vessels in the septa are also visible. Stained with hemotoxylin and eosin.10x10.

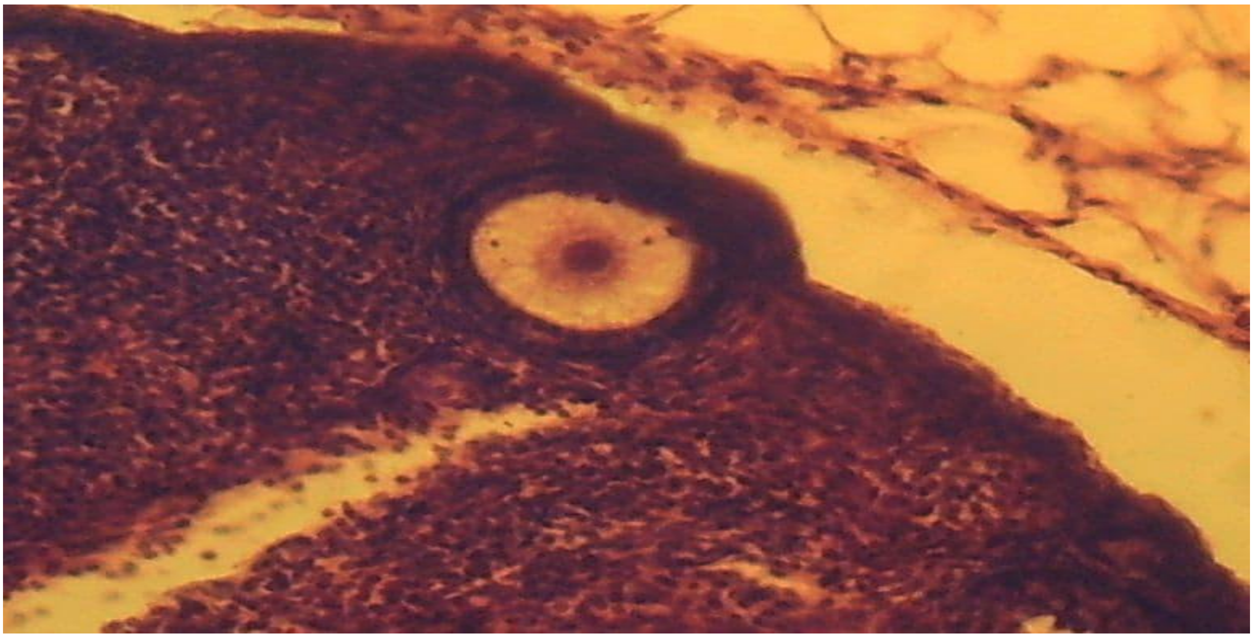

Fig. 2. The thymus lobule is represented by two clearly distinguishable areas-the cortical and medullary

matter, and the strands of connective tissue and blood vessels are also visible. Stained with hemotoxylin and eosin.10x10.

Conclusion

Microscopic examination of the thymus after feeding GMOs in animals found that after a certain period of time after the introduction of a sharp reaction develops, i.e. underdevelopment, which progresses with an increase in the duration of the experiment. Thus, the results of morphological studies have shown that in rats, when using GMOs, pathological changes are often found. Changes in the thymus when using GMOs should be taken into account when choosing treatment tactics, and developing preventive measures for both immunodeficiency states and its complications.

Acknowledgment:

The effect of GMOs on the thymus leads to a selective lesion between the parenchyma and stroma, perhaps these changes are based on a specific reaction of the thymus in response to the introduction of GMOs, which leads to a weakening of immunity, the occurrence of allergic reactions, the formation of resistance to antibiotics and a decrease in the effectiveness of treatment and the process of accumulation in the body.

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