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# Comparative Analysis of Morphological Changes Occurring in The Thymus in Mild Traumatic Brain Injury

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***Abstract***

*In the experiments, 34 white thoroughbred rats aged 1,3,6 months were used. These are white non-breeding rats of both sexes weighing on average about 250-300 g. The rats were fixed on a self-propelled vehicle with manual control, and in the moving vehicle, the experimental rats approached the wooden barrier and hit them on the forehead, which led to brain injury. The speed of the car was 6.7 km per hour. In the course of experiments on a traffic accident, 30 rats survived and 4 rats died. In general, i.e. macroscopic view of the thymus of 1,3,6-month-old white rats, changes are observed depending on the month, varying degrees of morphological changes in the state of fatty metamorphosis in the thymus cortex, consisting of lymphoid cells (thymocytes), blood vessels, Hassali cells and epithelial cells.*

**Keywords:** *: Traumatic Brain Injury, The Immune System, Autoimmune Reactions; Gassali Cells, Inflammation Fat Metamorphosis*

## 1. Introduction

In the last 10-15 years, research in the field of immunology, new information about the structure of the immune system, the functions and mechanisms of innate and acquired immune cells, the development of immunopathological effects on the brain and the protective effect of immunity, connective tissue repair in general. The mechanism of development of the immune response to injury (TMS) neurotrauma is considered: These include: 1) primary activation of innate immune cells immunity, ie microglia in the brain, 2) synthesis of cytokines by microglia and involvement of peripheral immune cells in the parenchyma 3) systemic specific immunity and the development of inflammation are reactions in the body.

The development of immune reactions after a given TMS can have a two-way effect over time: 1) an attempt to clear the brain of dead cells and stimulate the recovery of neurons, 2) an immunopathological effect at the time of injury, which can lead to early or delayed neurodegeneration after TMS. With this in mind, further study of immune processes has led to the development of targeted immunomodulatory methods for TMS, which are the consequences of acute TMS and its long-term treatment outcomes. [1]

Separate groups of thymus lobules are located around or in the thickness of thyroid tissue, in the soft tissues of the neck, in the fatty tissue of the anterior, rarely posterior mediastinum of the tonsils. Aberrant thymus detection rate reaches 25%. Such anomalies are most often observed in women, mainly on the left side of the neck and mediastinum. The literature contains specific data on ectopic thymus tissue in infants. Such pathologies are accompanied by shortness of breath, dysphagia and respiratory failure. P. According to Novak et al, cervical localization is detected on the left side in 76 out of 91 cases of thymus ectopia, mainly in men. Thymus ectopy is also associated with congenital heart defects in 71% of cases [2,3].

## 2. Materials And Methods

We used 34 1.3.6-month-old white pedigree rats in the experiments. They are white non-breeding rats of both sexes weighing an average of around 250-300 g. The rats were fixed to a hand-wheeled self-propelled vehicle, and in a moving vehicle, the experimental rats came to a wooden barrier and hit them on the forehead, resulting in a brain injury. The speed of the vehicle was 6.7 km per hour.

During the experiments of the road traffic accident, 30 rats survived and four rats died. In the general, ie macroscopic view of the thymus of 1.3.6-month-old white rats, changes depending on the month are observed, different levels of morphological changes in the state of fat metamorphosis in the cortex of the thymus, consisting of lymphoid cells (thymocytes), blood vessels, Gassali cells and epithelial cells were noted. Growing neurotraumatic conditions worldwide, increasing disability and increasing mortality rates require constant study of the medical and social aspects of the problem.

It should also be noted that traumatic brain injury accounts for 30-40% of injuries and is the leading cause of permanent and temporary disability in the population, as well as cardiovascular and oncological diseases among the causes of death in middle-aged people [4,6 ]. Against the background of traumatic brain injury in the immune system of the body, respectively, broncho-pulmonary complications and autosensitization of the body, in particular, the emergence of autoantibodies to antigens of brain structures, leads to disruption of the range of action of all T-lymphocytes and V-lymphocytes [1,5]. The effect of various factors on the body of origin may be manifested by hypofunction or hyperfunction of the thymus. The attenuating effect (e.g., stress, ionizing radiation, severe pathological conditions of the body and the influence of other environmental factors on the outside) is manifested by increased proliferation and orientation of cells responsible for the immunological state, increased delimitation, apoptosis and decreased macrophage activity. [6,7,8]. To date, detailed studies on the effects of traumatic brain injury on the thymus structure have been virtually non-existent. At the same time, the research will help to understand the effects of exogenous factors and the mechanisms of immune response that occur after traumatic brain injury and to study in more depth the impact of traumatic brain injury on changes in morphofunctional parameters in the thymus.

The experiment was performed on 34 white-bred rats aged 1.3.6 months. Rats were composed of representatives of both sexes and their average weight was 250-300 grams. The animals were immobilized on a hand-held device, i.e. a wheeled vehicle, then the laboratory rats were accelerated in the vehicle (speed - 6.7 km / h) and hit a wooden barrier with the forehead of the head. As a result of this experiment, 4 white rats died on the spot. Prior to injury, all rats were trained for 4 days in the Morris water labyrinth to develop cognitive memory retention and water survival skills, which were evaluated by time and area mobility indicators. After receiving a traumatic brain injury, the rats were again retested to determine movement patterns in time and area, as a result of which all experimental animals were divided into three subgroups according to the results of the last indicators, depending on the degree of injury. (For mild, moderate, and severe injuries). This article presented the results of animals with only mild traumatic brain injury. Different levels of complications were observed in the rats after the injury (tremors, nosebleeds, bleeding from the mouth, short-term fainting, etc.). All 34 laboratory rats were decapitated in place immediately after the experiment by removing their heads from the body. After the chest was opened, the thymus was removed for examination. All experiments on laboratory animals were performed in accordance with the 1964 Helsinki Declaration of the International Medical Association. The removed thymus and its parts were immersed in Buena solution and placed in paraffin. It was then prepared and stained in hematoxylin-eosin solutions in sections 6–7 μm in size. Morphometric studies were performed under the NLCD NOVEL-307B (China) microscope.

**3. Results and Discussion**

Changes in the thymus of 1.3.6-month-old white rats after minor brain injuries vary with age. Examination of lymphoid cells (thymocytes) in 1-month-old rat thymus 3 days after brain injury showed a decrease in the number of thymocytes (20-30%), narrowing of local blood vessels, dilation of the barrier separating the cortex and core layers (15-20%). until the state of fatty metamorphosis is enlarged (25-35%), it can be seen that the shape of Gassali cells is almost unchanged.

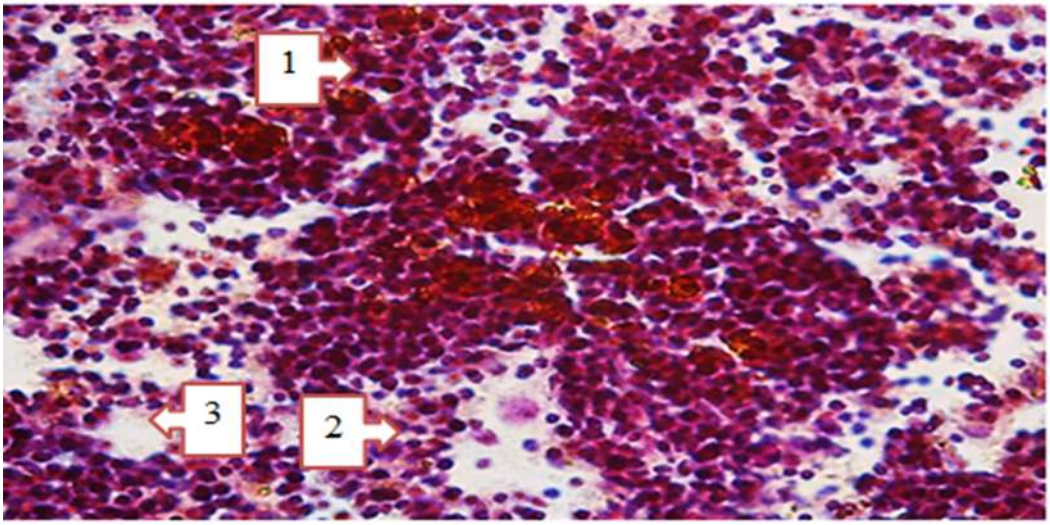


**Figure 1:** Picture. 3-month-old rat. 1. Rare lymphocytes.2. Local blood vessels are dilated. 3. Dilated blood vessels

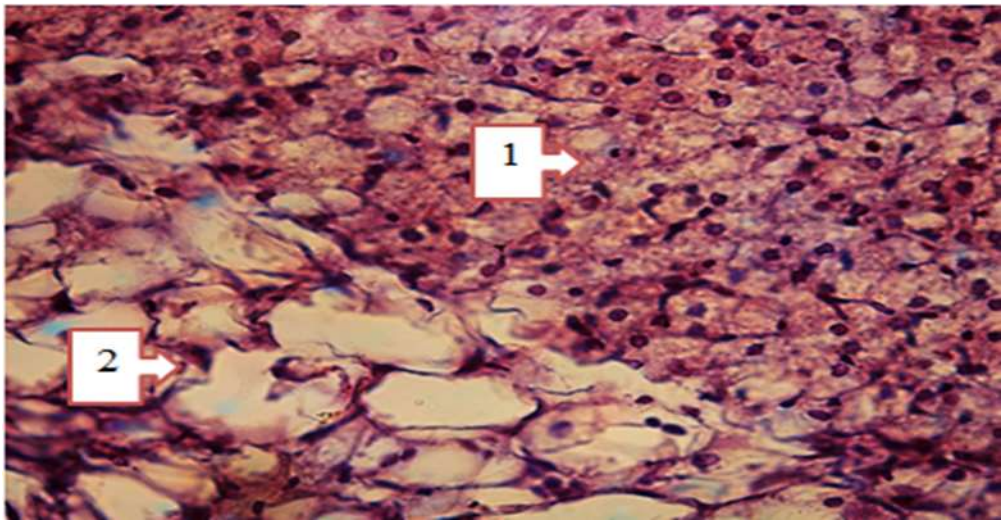


**Figure2:** picture. 3-month-old rat. 1. Decreased number of lymphocytes 2. Areas of fat metamorphosis have increased

Changes in the thymus of 3.6-month-old white rats after minor brain injuries vary with age. When the lymphoid cells (thymocytes) were examined in the 3.6-month-old rat thymus 3 days after brain injury after TMS, the number of thymocytes decreased to 50-60%, the local blood vessels there narrowed, and the barrier separating the cortex and core layers widened (30-50%). , until the state of fatty metamorphosis is enlarged (60-70%), it is possible to see the unevenness of the boundaries of the deformed cells of Gassali.

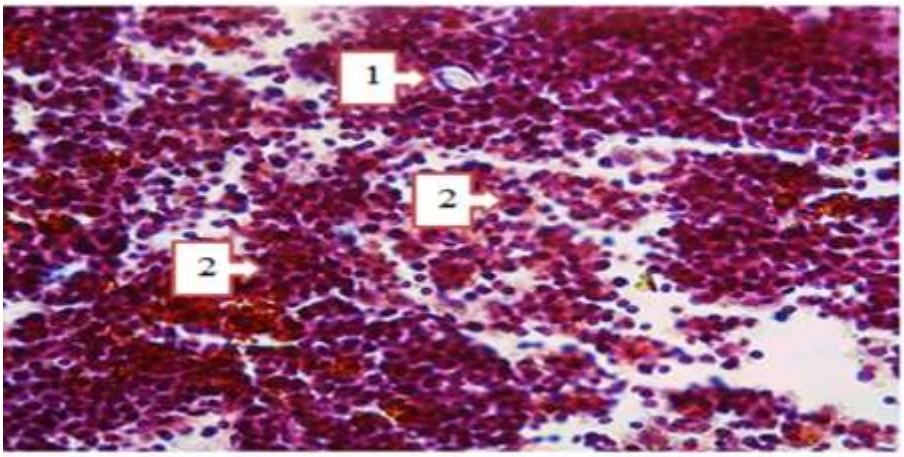


**Figure 3:** picture. 1. Dilated blood vessels 2. Decreased lymphocyte count

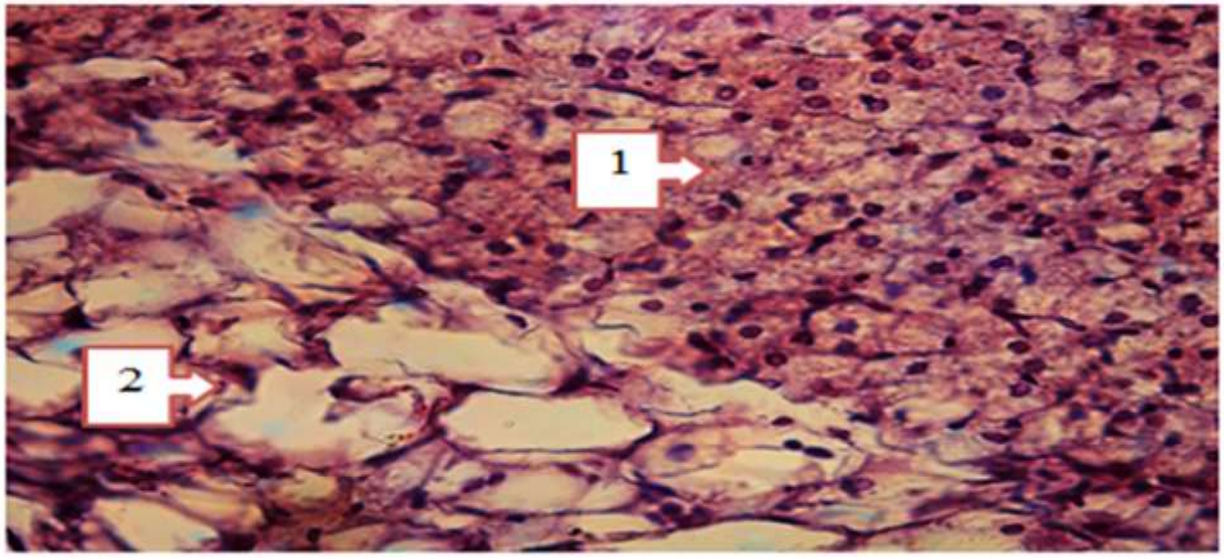


**Figure 4:** picture. 1. Decreased number of lymphocytes 2. Expanded areas of fat metamorphosis

The size of organ lobules in the thymus was determined by their length and diameter, total area of lobules, area of arbitrary units of cortical and medulla zones, as well as large-scale composition, decreased number of medium and small lymphocytes in cortical and medulla lobules, and widened interval. [9,10]

## 4. Conclusion

Studies have shown that in cases of traumatic brain injury in animals, i.e. 3 days after a mild injury in rats, some changes in the structure of the thymus, i.e. decreased lymphocyte count and dilation, increased fatty metamorphosis areas, dilated blood vessels. Changes are also observed in the Gassali cells of the thymus.

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