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Morphofunctional Structure of Thimus in Children in Different Regions

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Abstract: Today one of the most important problems for researchers is the study of morphology, physiology and pathology of the immune system, which is primarily related to the demands of clinical medicine. New environmental, social and other factors have also begun to have a significant impact on the human body. The thymus gland, being an endocrine gland, plays a major role in the formation of the child's body. The aim of the study is to determine the structure of the thymus gland in children in different regions. We have studied the structure (macromicroscopic picture) of thymus in 39 cadavers of children. Methods of research: anatomical methods (dissection, weighing, measuring); histological methods (staining with hemotoxylin-eosin, Van-Gieson). For histomorphologic study, pieces of thymus tissue were taken and fixed in 10% formalin solution. As a result of thymus study in children, it is small in size, pinkish-gray in color, soft consistency, its surface is lobulated. On average, it is from 10 to 18 g. In children, the longitudinal dimensions of the right lobe range from 5.0 ± 8.2 cm (average - 6.6), the left lobe - from 5.2 ± 5.9 cm (average - 5.55). Transverse dimensions of the right lobe range from 1.8 ± 2.7 cm (mean - 2.2), left lobe - from 1.6 ± 3.6 cm (mean - 2.6). The thickness of the right lobe ranges from 0.8 to 1.4 cm (average 1.1). In children of the second period of childhood, it was found that in the thickness of the cerebral layer there are Hassall's corpuscles of different sizes, blood capillaries, and lymphatic slits. The cellular composition of the cerebral layer is diverse, with large numbers of lymphocytes, larger light-colored epithelial-like and reticular cells, and macrophages. In the cortical zone the cellular composition is mainly lymphoid elements, in some of them mitoses are detected, the cortical zone prevails over the cerebral zone. We have established that there is a direct connection between changes in the thymus gland (morphological structure) from the place of residence in Kyrgyzstan.

1 INTRODUCTION

There are quite a lot of works on the study of morphology of the central organs of the immune system. However, information on the age aspect of the immune system organs, as well as the study in different climatic-geographical and environmental conditions of Kyrgyzstan is rare. In mountainous regions mining and cattle breeding are intensively developed, they are used as recreation and climatotherapy zones, which, naturally, leads to increased migration processes of the population to these climatogeographical areas In Kyrgyzstan on its relatively small territory of about 199 thousand km and with a population of 6 million people there are 49 tailing dumps and 80 rock dumps, where 70 million meters of uranium production waste are buried for more than 60 years.

All of them, getting into the biosphere, have a negative impact on its individual components, including plants, animals, and humans". The thymus gland not only collects an army of lymphocytes, but also produces thymic hormones that activate the immune system, improve skin regeneration, and promote rapid cellular repair. Children with thymus

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gland pathology have a high mortality rate. The main functions of the thymus gland (lymphatic, immunoregulatory and endocrine) are realized mainly due to the secretion by epithelial cells of hormones, mainly of polypeptide nature - thymosin, thymopoietin and others. Literature data indicate the functional importance of thymus in all periods of postnatal life. At the same time, the data on the age characterization of the structural components of the human thymus are controversial, which is primarily due to the different gradation of age groups by researchers and the study of this organ mainly in children of the second period of childhood. Scientific data is a necessary element in clinical medicine for proper treatment and preventive measures in persons with different degrees of involution and pathology of the thymus.

The aim of this study is to investigate the effect of radioactive background on the structure of the thymus gland in children in the second period of childhood in different regions of Kyrgyzstan.

Materials and methods of research. The anatomy of the thymus gland was studied on 39 cadavers of children from causes not related to immune-deficiency states.

Methods of research: anatomical methods (dissection, weighing, measuring); histological methods (staining with hemotoxylin-eosin, Van-Gizon). For histomorphologic study, pieces of thymus tissue were taken and fixed in 10% formalin solution. Sections of the preparations were stained with hematoxylin-eosin and Van-Gizon staining Statistical processing of the results was carried out using the program: MS Excel.

2 OWN RESULTS

After autopsy of the cadaver, thymus in children is small in size, pinkish-gray in color, soft consistency, its surface is lobulated. On average, it ranges from 10 to 18 g. In children, the longitudinal dimensions of the right lobe range from 5.0 ± 8.2 cm (average - 6.6), the left lobe - from 5.2 ± 5.9 cm (average - 5.55). Transverse dimensions of the right lobe range from 1.8 ± 2.7 cm (mean - 2.2), left lobe - from 1.6 ± 3.6 cm (mean - 2.6). The right lobe thickness ranges from 0.8 to 1.4 cm (average - 1.1). The thickness of the left lobe is 0.6 ± 1.4 cm (average 1.0). The upper border of the thymus gland is at the level of the sternum handle notch or 1.5 ± 2.6 (average 4.1) cm above it, the border of the right lobe is usually slightly higher than the left. The lower border of the gland extends beyond the body and the sternum handle: on the right 0.6 ± 2.1 cm (mean -1.3), on the left 1.3 ± 1.2 cm (mean -1.2).

On examination, the thymus gland is lush, consists of numerous lobules of different sizes, separated by layers of connective tissue. The thymus has a delicate, thin connective tissue capsule consisting mainly of elastic fibers, among which mainly collagen fibers are detected.

The gland tissue beneath the capsule consists of longitudinal layers of connective tissue fibers, predominantly collagen fibers. From the common capsule depart deep into the gland connective tissue septa, dividing the parenchyma of the gland into many lobules of different sizes. In children, the lobules are of different shapes - polygons predominate over oval-shaped lobules. In children the lobules of the gland consist of two zones: the light zones located in the center are identical in cellular composition, but in the dark, cortical zone the cells are very densely located, their number is much greater than in the center of the cerebral zone. In the thickness of the cerebral layer there are Hassall's corpuscles, blood capillaries, lymphatic slits. The cellular composition of the cerebral layer is diverse, there are lymphocytes in large numbers, larger light-colored epithelial-like and reticular cells, as well as macrophages. In the cortical zone, the cellular composition is monomorphic, mostly lymphoid elements, some of which show mitoses. The cortical zone prevails over the cerebral zone (Fig.1,2) In Figure 1 we see that the highest indicators of the cortical substance in the thymus gland in children in Naryn region, in Bishkek city the second place, the lowest indicators in Cholpon-Ata city.

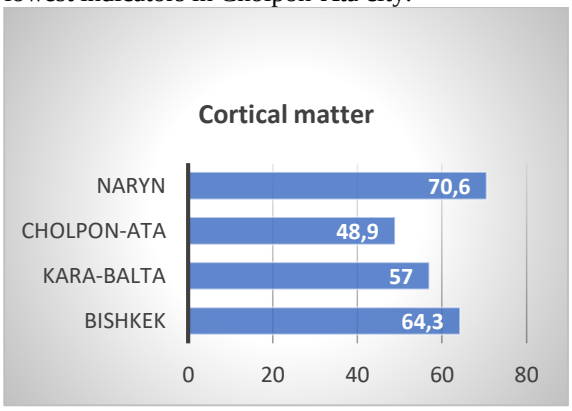

Figure 1: Cortical matter by regions of Kyrgyzstan. x-regions--u- stereometric data.

Data of comparative analysis of cortical substance of thymus gland differs from brain substance have

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divergence only on Cholpon-Ata city, where Kara-Balta is ahead, according to figure 2.

y-regions,x- stereometric indicators in percentage of brain matter

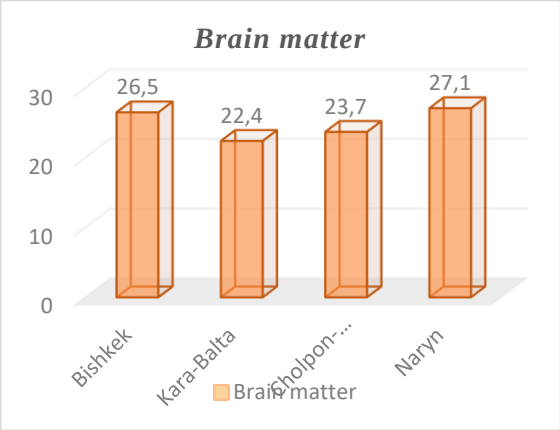

Figure 2: Brain matter by regions of Kyrgyzstan.

Different “age” of Hassall's corpuscles in the brain layer is noticeable (Fig.3), the highest indicators are in Bishkek city, followed by Naryn, Cholpon-Ata, Kara-Balta.

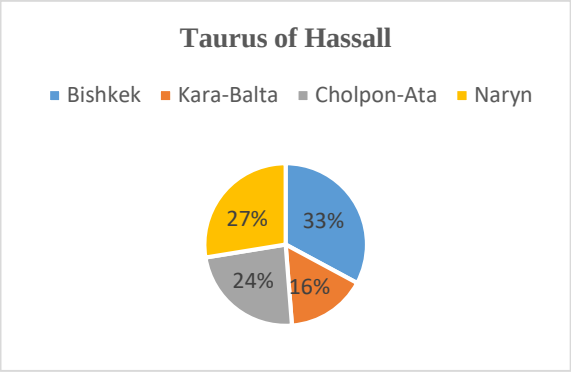

Figure 3: Hassall's corpuscles by regions of Kyrgyzstan.

The number of macrophages is clearly expressed. Full-blooded blood vessels are adjacent to the intra-lobular septum. Reticular bases of lobules are expressed clearly enough.

In children, the cortical layer contains a large number of lymphocytes located compactly. Usually lymphoblasts (26%) are found under the capsule. Lymphoblasts are also found in the medullary layer (39%), but much less than in the cortical layer (35%). In the lobules there are elements of atrophy in the form of adipose tissue overgrowth.

Indices of lymphoblasts in deceased children of Bishkek compared to deceased children of Kara-Balta city indicate 11.7% less, in Cholpon-Ata city 5.7% less, and in children of Naryn city 10.7% more. It was found that the indicators of small number of lymphocytes of Bishkek city compared to the deceased children of Kara-Balta city is 30.9% less, Cholpon-Ata city 39.4% less indicators and Naryn city 6.4% less indicators. Average lymphocytes in Kara-Balta is 26.5% less compared to the deceased children of Bishkek, average lymphocytes in the deceased children of Cholpon-Ata is 24.7% more, and in children of Naryn is 6.4% less.

Naryn 29.0% less average lymphocyte counts compared to Bishkek deceased children.

Apoptotic bodies in children of Cholpon-Ata compared to children of Bishkek by 9.1% less, Naryn apoptotic cells by 4.0% less, and in deceased children of Kara-Balta is 12.4% less apoptotic bodies. The mitosis indicators of Bishkek city are 25.0% less compared to the indicators of Kara-Balta city, and the residents of Cholpon-Ata city have 21.1% less mitosis. In deceased children of Naryn, mitosis indicators are 11.5% less than in Bishkek. Macrophage indices in deceased residents of Kara-Balta compared to deceased residents of Bishkek are 29.1% less, in Cholpon-Ata 2.8% less, and in deceased residents of Naryn 15.9% more. According to the data of stereometric characterization of thymus (Fig.2,3,4) in children of the second period of childhood on the index of intra-lobular perivascular space (IVPS) of IVPS it is noted that in comparison with the deceased residents of Kara-Balta 32,5% less in comparison with Bishkek, and Cholpon-Ata 23,5% less, and Naryn compared to the indicators of Bishkek to is 42,6% more (Fig3).

x-stereometric data of septal lobes

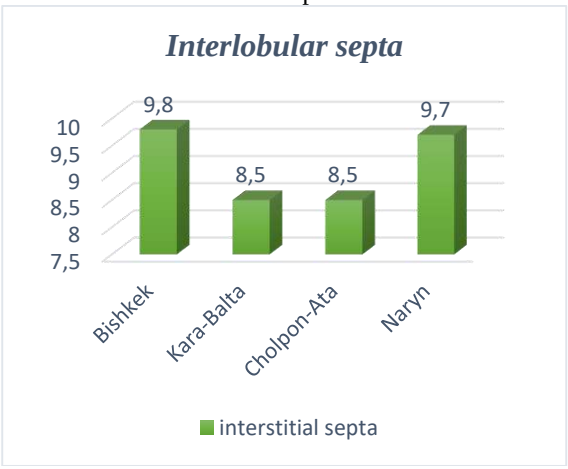

Figure 4: Interval septa by regions of Kyrgyzstan.

3 DISCUSSION

There are many works in the world devoted to the studies of thymus gland in which they determined its size, weight and revealed the features of echographic picture, as well as blood flow in the norm and in pathological conditions of the neonatal period. We have studied the morphologic structure of the thymus in different regions of Kyrgyzstan, and our studies concerning the size and weight of the thymus are confirmed with the data of other researchers. Undoubtedly, a certain disadvantage is that our study does not include the data of echographic picture and the state of the neonatal period, which were in the works (Kulagina, 2008; Rabovskaya, 2004). There is a more detailed study of thymus morphology in adult humans as well as children, which can be found in the studies of scientists. According to these works (Babaeva, Spore, 1987; Portnov, 2007; Smyslova, 2016; Goldstein, Maskey, 1969). analyzed the initial stages of atrophy in childhood, but in our study the histological analysis of thymus in the second period of childhood was carried out in the aspects of the influence of radioactive background in different regions of Kyrgyzstan. A group of scientists led by Professor Tukhvatshin R.R. believe that the results of rapid development of metallurgy, nuclear power and chemical industry have brought mankind to an ecological catastrophe, which is in full agreement with the data of other researchers.

4 CONCLUSION

Our hypothesis about the influence of radioactive background on the thymus in the second period of childhood was confirmed by the following data: the indices of lymphoblasts in the deceased children of Bishkek compared to the deceased children of Kara-Balta indicated 11.7% less, in Cholpon-Ata 5.7% less, and in the children of Naryn 10.7% more. It was found that the indicators of small number of lymphocytes of Bishkek city compared to the deceased children of Kara-Balta city is 30.9% less, Cholpon-Ata city 39.4% less indicators and Naryn city 6.4% less indicators. The average lymphocyte count of Kara-Balta city is 26.5% less compared to that of the deceased children of Bishkek city, the average lymphocyte count of the deceased children of Cholpon-Ata city is 24.7% more, and the average lymphocyte count of the deceased children of Naryn city is 29.0% less compared to that of the deceased children of Bishkek city. According to the data of stereometric characterization of thymus in children of the second period of childhood by the index of intra-valvular perivascular space (IVPS) of IVPS it was noted that compared to the deceased residents of Kara-Balta city 32,5% less in comparison with Bishkek city, and Cholpon-Ata city 23,5% less, and Naryn city compared with Bishkek city indicators to is 42,6% more. We found that there is a direct relationship between changes in the thymus gland in children in the second period of childhood and the place of residence in Kyrgyzstan. Thus, the morphology indicators of the thymus gland specifically in Kara-Balta and its regions in the places of burial of radioactive elements in children have more pronounced changes in the structure of the thymus gland, compared to other regions of Kyrgyzstan. Thus, changes occurring in the thymus lead to early atrophy and morphological changes, which negatively affects the health of children. This work is of theoretical and practical importance, as it fills the gap of knowledge about changes in the thymus gland from the place of residence in children of the second period of childhood, as well as provides an opportunity to undertake targeted assistance to the population, in the locations of the greatest risk of disorders in the structure of the thymus. Recommendations will be given to the Ministry of Health on carrying out dispensary measures in places of expressed radioactive background.

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