

Osinskaya A.A., Fedorova A.I.

Structural Changes of Peripheral Bodies of the Immune System at Different Types of Antigenic Action in an Experiment

ABSTRACT

We studied the microanatomical organization of larynx lymphoid tissue and mesenteric lymph nodes of rats based on antigenic exposure. Changes in the larynx lymphoid tissues were analyzed after diamond dust exposure to a body in different periods of the experiment. Mesenteric lymph nodes were examined after experimental exotoxicosis through the intraperitoneal injection of 50% oil solution of carbon tetrachloride. We determined that the 3-day exposure to a larynx mucous membrane with diamond dust caused increase of the number of lymphoid tissue. The prolonged exposure (30 days) resulted in reduction of the amount of lymphoid tissue on larynx walls. In MLN as a reaction to exotoxicosis the hypertrophy of paracortex, cortex, lymphoid nodules, and growth of pulpous strands, marginal, cortical and medullar sinuses in lymph nodes were observed. In both cases the changes occurred due to the activation of a lymphoid apparatus focused on processing the toxicant.

Keywords: lymph nodes, lymphoid tissue, diamond dust, toxicosis

Over the last years there has been substantial interest in immune system structure and functions. This can be explained with the results of modern scientific papers indicating participation of the immune system in foreign substances inactivation and a body detoxication; violation of its capacity leads to development of various pathological processes in tissues and organs of the body [5]. An important role in organism abient responses under exotoxic states belongs to lymph nodes, which fulfill important regulatory-and-adaptive as well as barrier functions; they are largely in charge of drainage and detoxication of a lymphatic zone [1], as well as lymphoid tissue, which is one of the most sensitive body systems quick on contact with antigens at the earliest stages. Reaction of lymph nodes and lymphoid tissue of organs aims to treat arising disorders under the damaging factors action [3,7].

At present there is a significant progress in the study of certain organs of immune system [6]. Meanwhile, there is not due attention to the study of structural processes relationship on exotoxic exposure to a body in lymph nodes and lymphoid tissue.

In this paper we have attempted to combine data on structural changes in the peripheral organs of an immune system on different types of antigenic exposure.

The aim: to identify presence or absence of similar changes in the structure of the peripheral organs of the lymphoid system on different types of antigenic exposure.

MATERIALS AND METHODS

We selected 100 Wistar rats weighing 150-180 g. at the age of 3-4 months. For microanatomical study we chose larynx lymphoid tissue and mesenteric lymph nodes. Changes in the larynx lymphoid tissues were studied after exposure with diamond dust in different periods of the experiment. Mesenteric lymph nodes were studied after experimental exotoxicosis.

For exposure with diamond dust the animals were placed in the diamond hand-cut workshop of the lapidary plant of "Aurora Diamond" JSC of the Republic of Sakha (Yakutia). The animals were slaughtered on the 3rd and 30th days of the experiment. For formation of experimental exotoxicosis the animals were intraperitoneally injected 50% oil solution of carbon tetrachloride in a dose of 0.4 ml/kg. The animals were slaughtered by decapitation in the morning in 72 hours after the toxicosis formation.

The data was held in 10% neutral formalin solution for 24 hours and dehydrated in alcohols of increasing concentration and then put in paraffin. Paraffin sections of 5-7 microns thick were made with a sledge microtome. The sections were colored with hematoxylin and eosin. Morphometry of structure of the larynx walls and lymph node was performed by point counting with the use of a standard grid.

A relative area (in %) of the structural components – epithelium, mucosa, submucosa, glands and their excretory ducts, areas covered with diffuse lymphoid tissue and lymphoid cells nests - was measured on the microslides of the larynx walls.

We determined the area of the entire section and separate structures: capsules, cortex and medulla, sinuses in lymph nodes. We calculated the ratio of the specific area of the cortex to the specific area of the medulla (index C/M), the ratio of the cortical plateau area to the paracortical area (index C/P), and the ratio of the pulpous tissue area to the medullar sinuses area (index PT/CS).

All the received quantitative data were processed by the variation statistics method with definition of an arithmetic mean, its error and a confidence interval with the reliability of p-95% ($p < 0.05$); statistical significance between the parameters was indicated on the Student t-test.

RESULTS AND DISCUSSION

When studying microanatomy of the larynx walls, it was revealed that cells of the lymphoid tissue formed clumps located predominantly in a subepithelial zone of the larynx lamina propria and surrounded the glands' excretory ducts. The study found that on the third day of diamond dust exposure in the diamond hand-cut workshop there was a significant increase ($p < 0.05$) of the area covered with lymphoid tissue ($13,7 \pm 0,5$) on larynx duct - by 1.14 times relative to benchmarks ($12,0 \pm 0,2$). In interventricular larynx part, the area covered with lymphoid tissue was $15,4 \pm 0,3$, which was 1.2 times higher than the benchmarks ($13,3 \pm 0,4$). The infraglottic cavity had also significant ($p < 0.05$) increase of lymphoid tissue - by 1.2 times (benchmark - $11,4 \pm 0,2$; experiment - $13,4 \pm 0,4$).

The study of the larynx structural components after prolonged diamond dust exposure (for 30 days) showed that the amount of lymphoid tissue was 1.08 times smaller ($p < 0.05$) than the benchmarks ($11,2 \pm 0,2$) on the walls of the larynx duct; by 1,2 times - in the interventricular part ($11,7 \pm 0,07$); and by 1.1 times - in the infraglottic cavity ($10,9 \pm 0,1$).

Therefore, as a result of the study, we found that the 3-day exposure with diamond dust to the larynx mucosa caused lymphoid tissue increase. Such changes in the lymphoid tissue were estimated as the initial reaction of the immune system to the action of various toxic factors, which occurred as enhancement of lymphopoietic processes [2,4,5]. Prolonged exposure occurred with reduction of the lymphoid tissue on the larynx walls. We agree that these changes indicate the ongoing degradation processes resulting from chronic intoxication [2,5].

Under exotoxicosis induced by carbon tetrachloride in the mesenteric lymph node structure, the area of the cut nodes increases by 1.6 times (benchmark - $34,35 \pm 1,79$; toxicosis - $55,80 \pm 3,97$; $p < 0.001$) due to changes in intranodal zones as in the cortex and in the medulla. The cortex volume increased by 1.7 times (benchmark - $18,42 \pm 1,06$; toxicosis - $31,70 \pm 2,13$; $p < 0.001$) due to the significant increase in the area covered with the cortical plateau (benchmark - $4,27 \pm 0,19$; toxicosis - $6,60 \pm 0,70$; $p < 0.001$), paracortex (benchmark - $7,45 \pm 0,32$; toxicosis - $16,20 \pm 0,80$; $p < 0.001$), Marginal sinus (benchmark - $4,25 \pm 0,41$; toxicosis - $5,20 \pm 0,21$; $p < 0.05$), and cortical sinus (benchmark - $1,90 \pm 0,15$; toxicosis - $2,90 \pm 0,21$; $p < 0.001$). The area of lymphoid nodules tends to increase. The share of medulla in the lymph node structure

increases by 1.3 times (benchmark - $8,55 \pm 0,28$; toxicosis - $11,40 \pm 1,17$; $p < 0.001$). At that, the area of pulpous strand increases by 1.4 times (benchmark - $3,85 \pm 0,36$, toxicosis - $5,30 \pm 0,42$; $p < 0.05$), the area of medullar sinus - by 1.3 times (benchmark - $4,70 \pm 0,20$; toxicosis - $6,10 \pm 0,75$; $p < 0.001$). Evaluation of lymph node sinus system indicates its growth. Extension of sinus system is mainly achieved through the cortical and medullar sinuses. It is known that the lymph nodes can deposit a large amount of liquid. In the early stages of venous stasis the volume of lymph node increases by 40 - 50% compared to the normal volume due to accumulation of a large mass of liquid therein [8]. Index C/M is $2,78 \pm 0,91$, which characterizes the node as a compact II type. The value of the index C/P is $0,40 \pm 0,14$, which indicates the prevalence of paracortex in lymph nodes. Index PT/CS of $0,86 \pm 0,28$ indicates the prevalence of sinus share in the lymph node medulla.

Thus, hypertrophy of paracortical zone, cortical plateau, and lymphoid nodules, growth of pulpous strands, Marginal, cortical and medullar sinuses indicate immune activation aimed at the toxicant processing and the lymph node's transport function improving. The observed changes in the structure of the mesenteric lymph nodes are a response to the introduction of the toxin and they signify that lymph nodes are in a state of structural and functional stress.

COCLUSIONS:

1. The immune system peripheral organs exhibit high reactivity in response to various antigens. Changes in the lymphoid organs depend on duration of a foreign agent exposure.
2. Structural changes on the larynx walls after short antigen exposure, as well as changes in the lymph nodes after experimental exotocsicosis are qualitatively similar and occur through activation of the lymphoid apparatus aimed at the toxicant treatment.
3. Prolonged antigen exposure causes suppression of functional capabilities of lymphoid tissue, resulting in a reduction of its quantity.

References:

1. Buyanov V.M. Limfologija jendotoksikoza [Lymphology of endotoxiosis]. Moscow, Medicine, 1990. – P. 272.
2. Garmaeva D.K., Osinskaja A.A., Sapin M.R. Limfoidnye struktury dyhatel'nyh putej pri vozdejstvii almaznoj pyli v uslovijah granil'nogo proizvodstva Respubliki Saha (Jakutija)

- v jeksperimente [Lymphoid structures of the airways under exposure of diamond dust in a lapidary industry of the Republic of Sakha (Yakutia) in the experiment]. Yakutsk, NEFU Publ., 2010. – P. 278.
3. Garmaeva D.K., Fedorova A.I., Afanas'eva O.G., Sokolova R.G. Limfaticeskij uzel v jeksperimente: vospalenie, toksikoz, opuhol' [The lymph node in the experiment: inflammation, toxicosis, tumor]. Novosibirsk, Manuscript Publ., 2005. – P. 160.
 4. Osinskaya A.A. «Jekologija i zdorov'e cheloveka na Severe» sbornik nauch. trudov V Kongressa s mezhdunarodnym uchastiem. [Ecology and human health in the North: a collection of scientific papers of the V Congress with international participation]. Kirov, 2014. - P.70-73.
 5. Sapin M.R., Nikitjuk D.B. Immunnaja sistema, stress i immunnodeficit [The immune system, stress and immunodeficiency] Moscow, Dzhanger Publ., 2000. – P. 184.
 6. Sapin M.R., Jetingen L.E. Immunnaja sistema cheloveka [The human immune system] Moscow, Medicine, 1996. - P. 304.
 7. Fedorova A.I., Gorchakov V.N. Bjulleten' Sibirskogo Otdelenija Rossijskoj Akademii Medicinskih Nauk [Bulletin of the Siberian Branch of the Russian Academy of Medical Sciences]. 1999, Vol. 19, No. 2. - P. 125-129.
 8. Borodin Ju.I., Sapin M.R., Jetingen L.E. [i dr.] Funkcional'naja anatomija limfaticeskogo uzla [Functional anatomy of a lymph node]. Novosibirsk, Science Publ., 1992. - P. 257.

Authors:

Alena A. Osinskaya, Associate Professor of the Department of General and Pathologic Anatomy, Operative Surgery with Regional Anatomy and Legal Medicine of NEFU Institute of Medicine; contact phone number - 89241689844, osin_alen@rambler.ru

Aida I. Fedorova, Associate Professor of the Department of General and Pathologic Anatomy, Operative Surgery with Regional Anatomy and Legal Medicine of NEFU Institute of Medicine; contact phone number - 89241696871, fed.aida@rambler.ru