

Research Article

Changes in the Lymphoid Structures of the Small Intestine under the Influence of Adverse Environmental Factors

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Abstract

The work aimed to determine the number of lymphocytes in the lymphoid nodules and in the epithelial cover of the villi of the small intestine in normal conditions and under the influence of the herbicide cotorana, which passed through the mother's milk in the age aspect. The results of the study showed that in the experimental groups of rats in the early stages of the experiment in the lymphoid nodules and epithelial cover of the villi of the small intestine, the number of large, medium-sized lymphocytes increases, and small ones decreases. At 90 days of age, this difference is more smoothed out, due to the connection of compensatory mechanisms of the body.

Keywords: *Small intestine, lymphoid nodule, intraepithelial lymphocyte, herbicide cotoran.*

Introduction

One of the leading human immune organs is the small intestine [2,4,5,6]. Lymphoid formations of the small intestine are of great importance in maintaining the immune status of the body. The lymphoid tissue of the small intestine is the first element of the immune defence of the digestive tract. It makes up a quarter of the entire immune system, including lymphoid nodules of the small intestine. Currently, the protection of the environmental health of the population is an urgent problem on a global scale. The predominant part of environmental pollutants is pesticides, without the use of which it is impossible to develop agriculture in the future [1,3,7].

The study of the effect of modern widespread herbicides on the immune system, on the lymphoid apparatus of the gastrointestinal tract, on the mucous membrane of the digestive tube, especially on the interepithelial lymphocytes and the quantitative ratio of lymphocytes in the lymphoid nodules of

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the small intestine, would allow us to obtain new data on the pathogenesis of several diseases not only of the gastrointestinal tract but also of the entire body [8-14].

The aim of this study: To study the quantitative content of lymphocytes of the epithelial cover of the villi of the small intestine and the cellular composition of lymphoid nodules throughout the intestine in the control and experimental groups of rats in the age aspect.

Materials and Methods

To achieve the goal, the study was carried out on 120 rat pups. Female rats of the experimental group were injected intragastrically with cotoran at a dose of 0.05 mg using a probe. Immediately after the birth of the rat pups, the mothers were injected daily intragastrically at a dose of 1/100 LD50 for 16 days (the suckling period of the rat pups). Females of the control group received 1 ml of distilled water through a tube. The rats were slaughtered on the 1st, 30th, 60th, and 90th days of postnatal ontogenesis. After opening the abdominal cavity, the small intestine was removed and pieces were taken from the initial, middle and lower segments of the small intestine. The materials were fixed in Bouin's solution, carried out with alcohols of increasing concentration, and embedded in paraffin. From the blocks on a microtome, sections were cut with a thickness of 5-10 μm , and stained with hematoxylin-eosin.

We studied the cellular composition of the lymphoid structures in different parts of the small intestine and their changes under the influence of which. Cell counting was carried out using a morphometric grid mounted in the eyepiece of the objective -100, eyepiece-10. The number of small, medium and large lymphocytes in the centre of the proliferation of lymphoid follicles was counted under a microscope.

Determined the degree of infiltration of the integumentary epithelium of the small intestine per 100 epithelial cells of the villus.

The data obtained in the study were subjected to statistical processing on a Pentium IV personal computer using the Microsoft Office Excel - 2012 software package, including the use of built-in statistical processing functions.

Results and Discussion

The immune system of the small intestine consists of interepithelial lymphocytes, single and grouped lymph nodes.

One cannot but agree with the data of F.Kh. Azizova (2001) on the intestinal immune system, where the author divides the intestinal immune system into:

- Primary, including the epithelium and lamina propria, a mucous membrane with interepithelial lymphocytes.
- Secondary, lymphoid tissue of the Peyer's plaque.
- Tertiary, represented by regional mesenteric lymph nodules.

R.M. Khaitov, BV Pinegin (2003) believe that one of the main components of the immune system of the mucous membranes is interepithelial lymphocytes, the number of which increases after birth, which is associated with the ingestion of various antigens.

Our studies have shown that in the epithelial cover of the villi of newborns, there is a weak lymphocytic infiltration, where the number of lymphocytes per 100 epithelial cells ranges from 6 to 11, averaging 6.9 ± 0.6 . The average number of small lymphocytes is 3.8 ± 0.25 , medium lymphocytes - 2.2 ± 0.2 , large - 1.6 ± 0.3 . In our opinion, such a small number of lymphocytes can be explained by the sterility of the intestine, the absence of microbes at this age.

And in the control group, from a newborn to 90 days of age, the number of interepithelial lymphocytes of the mucous membrane of the small intestine increases 1.07 times. The highest growth rate of large lymphocytes is observed at 60 days of age (26.3%), medium lymphocytes at 30 days of age (16%), small lymphocytes at 30 days of age (34%), and the smallest growth rate of large lymphocytes (8, 3%) and medium lymphocytes (9.38%) occurs at 90 days of age, small lymphocytes at 30 days of postnatal development (Table 1).

Table 1

Cell Composition of Interepithelial Lymphocytes of the Mucous Membrane of the Small Intestine of Rats in Normal Conditions and When Exposed from a Newborn to 90 Days of Age

Age	departments bowel	Large lymphocytes		Average lymphocytes		Small lymphocytes	
		TO	E	TO	E	TO	E
Newborn	Elementary	1.6 ± 0.3		2.2 ± 0.2		3.8 ± 0.2	
	7.6 \pm 0.3						
	Middle	1.7 ± 0.1		2.0 ± 0.2		4.5 ± 0.3	
	8.2 \pm 0.2						
30 days	Finite	2.0 ± 0.2		3.5 ± 0.25		6.25 ± 0.4	
	11.7 \pm 0.3						
	On average	1.7 ± 0.2		2.5 ± 0.2		4.85 ± 0.3	
	Start	1.6 ± 0.2	$3.1 \pm 0.2^*$	2.6 ± 0.18	$5.0 \pm 0.25^*$	5.8 ± 0.25	7.0 ± 0.31
60 days	Middle	1.8 ± 0.2	$3.4 \pm 0.25^*$	2.8 ± 0.2	$5.3 \pm 0.25^*$	6.5 ± 0.3	7.8 ± 0.4
	11.2 \pm 0.55						
	Finite	2.2 ± 0.12	$3.7 \pm 0.25^*$	3.2 ± 0.18	$5.7 \pm 0.31^*$	7.1 ± 0.3	8.6 ± 0.31
	12.8 \pm 0.4						
90 days	On average	1.9 ± 0.17	3.4 ± 0.2	2.9 ± 0.19	5.3 ± 0.26	6.5 ± 0.3	7.8 ± 0.3
	Elementary	2.2 ± 0.12	2.8 ± 0.2	3.1 ± 0.18	$4.7 \pm 0.24^*$	5.9 ± 0.2	6.7 ± 0.3
	11, 2 \pm 0, 37						
	Middle	2.4 ± 0.12	3.2 ± 0.25	3.2 ± 0.12	$5.0 \pm 0.31^*$	6.9 ± 0.2	7.4 ± 0.4
90 days	Finite	2.5 ± 0.12	3.5 ± 0.25	3.4 ± 0.25	$5.7 \pm 0.3^*$	7.2 ± 0.3	8.5 ± 0.4
	131 \pm 0, 5						
	On average	2.4 ± 0.12	3.2 ± 0.2	3.2 ± 0.18	5.1 ± 0.3	6.7 ± 0.2	7.5 ± 0.4
	Start	2.0 ± 0.12	2.0 ± 0.2	2.7 ± 0.18	3.0 ± 0.25	6.1 ± 0.25	7.1 ± 0.4
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	10.8 ± 0.43						
Middle	2.2 ± 0.18	2.2 ± 0.2	3.0 ± 0.2	3.3 ± 0.4	7.2 ± 0.3	7.5 ± 0.4	
Finite	2.4 ± 0.19	2.7 ± 0.2	3.1 ± 0.25	4.6 ± 0.3	7.3 ± 0.3	6.9 ± 0.4	
On average	2.2 ± 0.16	2.3 ± 0.2	2.9 ± 0.2	3.6 ± 0.3	6.9 ± 0.3	7.2 ± 0.4	

Note: Sign * marks significant values ($P \leq 0.05$) in comparison with the control group.

In the experimental group of rats from 30 days to 90 days of age interepithelial lymphocytes of the mucous membrane of the small intestine increase 1.07 times. The highest growth rate of large lymphocytes is observed at 60 days of age (26.3%), medium lymphocytes - at 30 days of age (16%), small lymphocytes - at 30 days of age (34%), and the lowest growth rate of large (8.3%) and medium lymphocytes (9.38%) 90 days of age, small lymphocytes were noted at 30 days of postnatal development.

Our data on the cellular composition of interepithelial lymphocytes of the mucous membrane of the small intestine correspond to the data of G.G. Aminova et al (1992), who indicate that small lymphocytes are the main colonizing cells of interepithelial lymphocytes. V.A. Kryzhanovsky (2000), who also believes that the cellular composition of the diffuse lymphoid tissue of the mucous membrane is represented by reticular cells, a small number of plasma cells, macrophages and numerous small lymphocytes.

Several authors - Guanxiang Liang, Nilusha Malmuthuge (2016), Lisa Chedik, Dominique Mias-Lucquin, Arnaud Bruyere (2017), Lopes FM, Varela Junior AS (2014), Manuela Buettner and Matthias Lochner (2016) - have become considered as independently functioning part of the intestinal immune system.

Lymphoid follicles are fully formed from the neonatal period to 90 days of age. Already at 30 days of age, in the lymphoid follicles, the breeding centre, dome and mantle zone can be distinguished.

The study of the cellular composition of the centre of the proliferation of lymphoid plaques showed that in newborn rat pups, more than half of the lymphocytes are small (50.5 ± 0.35) lymphocytes, and the proportion of large (14.7 ± 0.2) and medium (33.9 ± 0.3) the lymphocyte count is slightly less than 50%. With age, this ratio changes: the number of small lymphocytes increases from 5 to 10% at 30 days of age, up to 10% at 90 days of age. The number of large lymphocytes at 60 days of age increases by only 2.2% compared with newborns.

And in the number of average lymphocytes, there is a decrease in their number with age: at 30 days of age, they are -29.1 ± 0.22 , at 60 days of age -26.5 ± 0.33 , and at 90 days of age even less -24.0 ± 0.31 . (Table 2.)

Table 2

Cell Composition of Peyer's Patches of the Small Intestine of Rats in Normal Conditions and When Exposed from Day 1 of Development to 90 Days of Age

Age	Departments Intestinal.	Large lymphocytes		Average lymphocytes		Small lymphocytes	
		TO	E	TO	E	TO	E
Newborn	Elementary	12.2 ± 0.2		37.6 ± 0.3		50.1 ± 0.4	

	Middle	16.5 ± 0.2		32.2 ± 0.3		51.6 ± 0.2	
	Finite	15.3 ± 0.2		31.8 ± 0.3		52.9 ± 0.4	
On average		14.7 ± 0.2		33.9 ± 0.3		50.5 ± 0.35	
30 days	Elementary	14.2 ± 0.25	19.4 ± 0.3 **	30.2 ± 0.25	34.9 ± 0.2 **	55.6 ± 0.3	45.7 ± 0.3 **
	Middle	16.1 ± 0.25	18.8 ± 0.2 **	29.2 ± 0.2	33.1 ± 0.2 **	54.7 ± 0.3	48.1 ± 0.25 **
	Finite	17.2 ± 0.2	20.9 ± 0.3 **	27.8 ± 0.2	32.2 ± 0.2 **	55.1 ± 0.3	46.9 ± 0.25 **
On average		15.8 ± 0.22	19.7 ± 0.29 *	29.1 ± 0.22 *	33.4 ± 0.2	55.1 ± 0.3	46.9 ± 0.27 *
60 days	Elementary	16, 5 ± 0.3	18.3 ± 0.25	28.2 ± 0.4	30.4 ± 0.2	54.8 ± 0.3	51.2 ± 0.25 **
	Middle	16.6 ± 0.4	17.2 ± 0.3	28.4 ± 0.3	29.8 ± 0.25	55.2 ± 0.4	52.9 ± 0.3 **
	Finite	17.6 ± 0.3	18.4 ± 0.4	23.1 ± 0.3	24.5 ± 0.4	59.4 ± 0.2	57.1 ± 0.4 **
On average		16.9 ± 0.33	17.9 ± 0.3 *	26.5 ± 0.33 *	28.2 ± 0.5	56.4 ± 0.3	53.7 ± 0.32 *
90 days	Elementary	14.9 ± 10.8 ± 0.43	15.1 ± 0.4	23.9 ± 0.3	24.5 ± 0.2	61.2 ± 0.25	60.4 ± 0.3
	Middle	15.9 ± 12.5 ± 0.55	16.1 ± 0.2	24.1 ± 0.4	24.2 ± 0.3	60.1 ± 0.3	59.6 ± 0.4
	Finite	16.1 ± 12.9 ± 0.55	16.3 ± 0.3	24.1 ± 0.24	25.1 ± 0.25	59.8 ± 0.25	58.6 ± 0.26
On average		15.6 ± 0.4	15.8 ± 0.3	24 ± 0.31	24.6 ± 0.23	60.3 ± 0.27	59.5 ± 0.3
Average for intestine		15.8 ± 0.29	17 ± 0.25	28.4 ± 0.29	30.0 ± 0.26	55.1 ± 0.31	52.7 ± 0.31

Note: Sign * marks significant values ($P \leq 0.05$) in comparison with the previous age.

Sign ** marks significant values ($P \leq 0.05$) in comparison with the control group.

Our data correspond to the data of M.Kh. Rakhmatova (2018), according to which all zones of the lymphoid nodule in the small intestine are fully formed by the age of maturity.

Kotoran also negatively affects the intestinal immune system, which consists of interepithelial lymphocytes of the mucous membrane and lymphoid nodules of the submucosa.

Under the influence of which, the quantitative ratio of lymphocytes in the lymphoid structures changes: the number of large and medium lymphocytes increases, the content of small lymphocytes decreases.

When lymphocytes infiltrate the epithelial cover of the villi of the small intestine in the early stages, when exposed to it, an increase in the number of large and medium lymphocytes is observed, and by the age of 3 months, the number of large, medium and small lymphocytes approaches the values of the control group. This suggests that in the early stages the intestine responds to the effect of which by an increase in the number of immature (large) lymphocytes, and at the age of 3 months, the lymphocytic balance is restored, and lymphocytic infiltration from the proximal to the distal increases.

Conclusion

1. Under the influence of this, the quantitative ratio of lymphocytes in lymphoid structures changes: the number of large and medium lymphocytes increases, the content of small lymphocytes decreases. These reactions are more pronounced in the early stages of the experiment
2. The study of the degree of lymphocyte infiltration of the epithelial cover of the villi of the mesenteric part of the small intestine showed that it increases with age in both groups of rats: from the proximal to the distal direction of the intestine. In the early stages of the experiment, an increase in the number of large and medium lymphocytes was observed against the background of a decrease in small ones, and by the age of 90 days, the quantitative composition of lymphocytes was close to that of the control group. This suggests that in the early stages of the experiment, the intestine responds to it with an increase in the number of immature (large) lymphocytes, and with age, the lymphocyte balance is gradually restored.

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