

Morphometric changes in the walls and lymphoid structures of the colon in radiation sickness

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Abstract. The study of age, individual, sex and anthropometric characteristics of the organism at different stages of development under different conditions is one of the most important tasks. The immune system depends largely on age, health, stress, environmental conditions and other factors. The study found that the length of the colon of rats of intact and irradiated groups showed that there was a decrease in its length, which is most pronounced at 3 months of age, in the following months of observation these indicators were at almost the same level. Thus, studies have shown that morphometric parameters of the colon (length, perimeter, thickness) increase unevenly with age.

1 Introduction

The purpose of the study: to study the features of lymphoid structures of the colon in radiation sickness. The key to normal growth, development, strong immunity and strengthening the heredity of the organism is undoubtedly the healthy state of the gastrointestinal tract. The system of the gastrointestinal tract occupies a special place in the relationship between the body and the environment. As it is known, the mucous membrane of digestive organs is affected by substances, which are included in the composition of food, and cause that the layers of the mucous membrane and submucous base have their own lymphoid formations, which are organs of immunogenesis.

The colon, unlike other organs of the gastrointestinal tract, has the ability to absorb water and is involved in faecal formation. Microflora, which populates the colon, plays an important role in the regulation of peristalsis, secretion, absorption, synthesis of biologically active substances. Structural changes in all membranes of the colon mucosa, submucosa, immune and enteric nervous systems characterise the postnatal development of one of its sections of the gastrointestinal tract.

2 Materials and methods

The study used 176 white randombred male rats at newborn and at 3, 6, 9, 12 months of age under normal vivarium conditions. At the beginning of the experiment, all sexually mature rats were quarantined for one week, and after somatic or infectious diseases were excluded,

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they were transferred to the normal vivarium regime. The animals were divided into 4 groups [n=176]: I-group - control [n=55];

II - group - rats irradiated for 20 days from the age of 70 days at a dose of 0.2 Grey [total dose was 4.0 Grey] [n=45]; III - group - rats that received irradiation for 20 days from the age of 70 days at a dose of 0.2 Grey [total dose was 4.0 Grey] and concomitantly received ASD-2 preparation during irradiation at a dose of 0.1 ml of pure ASD-2 dissolved in 0.4 ml of distilled water [n=44] for 20 days. IV- group - age 70 days rats, who received a course of irradiation for 20 days [from 2 months of age at a dose of 0.2 Grey, where the total dose was 4.0 Grey] and after the end of irradiation received the preparation ASD - 2 in a dose of 0.1 ml of pure ASD - 2 dissolved on 0.4 ml of distilled water [n=32] for 20 days. These dosages of ASD - 2 were calculated empirically and administered daily intragastrically as a solution. To model chronic radiation disease, rats were irradiated with DTGT apparatus "AGAT P1" of 25.006 c Grey /min [Estonia] for 20 days from 2 months of age at a dose of 0.2 Grey [total dose was 4.0 Grey].

3 Research results

The study established that the length of the colon of rats of intact and irradiated groups showed that there was a decrease in its length, which was most pronounced at 3 months of age (1.25 times), in the following months of observation these indicators were almost at the same level (1.02-1.04 times)

It was found that throughout the mesenteric colon of the intact group there is a decrease in perimeter from 1.4 mm (in newborns) - 3.8 mm (at 12 months of age) in the blind colon 1.7 mm (in newborns) - 3.9 mm (at 12 months of age) in the colon, to 1.3 mm (in newborns) -2.1 mm (at 12 months of age) in the rectum.

The irradiated group also showed a decrease in perimeter from 3.1 mm (in 3-month-olds) - 4.2 mm (at 12 months of age) in the cecum, 3.3 mm (in 3-month-olds) - 3.7 mm (at 12 months of age) in the colon, to 2.9 mm (in 3-month-olds) - 3.2 mm (at 12 months of age) in the rectum.

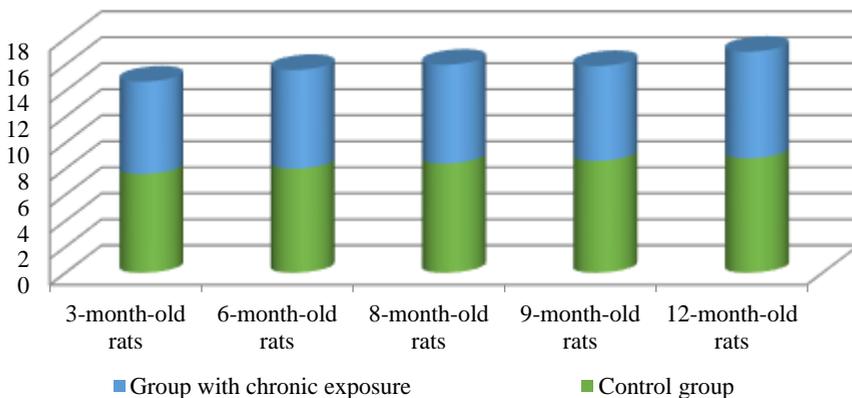


Fig. 1. Changes in the perimeter of the rat colon at age in the control and experimental groups.

It was found that the greatest decrease in the perimeter of the colon of rats with chronic irradiation was observed at 9 months of age (1.3 times), and the smallest at other ages (1.04-1.05 times) compared to the control group.

When comparing the thickness of the colon wall of rats with chronic irradiation of the initial, middle and final sections of the mesenteric part of the colon in all age categories lags behind in comparison with the control by 1.2-1.35 times (Fig. 2).

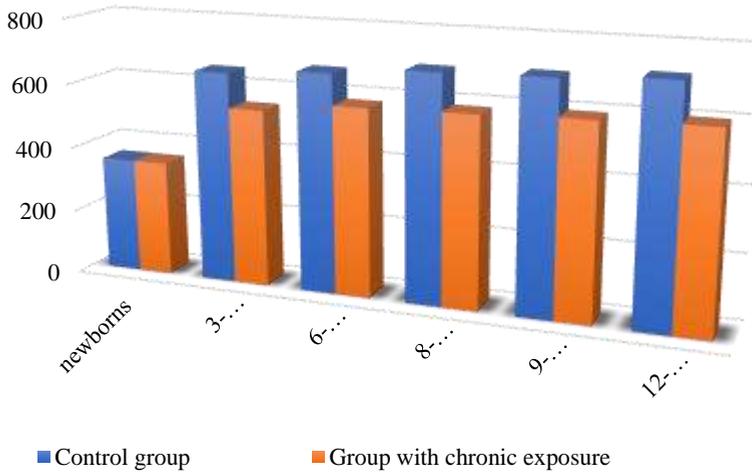


Fig. 2. Age-related changes in rat colon wall thickness in the control and experimental groups.

Single lymphoid nodules (SLN) in the colon of newborn rats are not detected.

The number of OLU in 3-12 months of age of the intact group increases from the blind intestine with an average of 15.2 ± 0.82 . In the colon, the number of OLU per 1 mm^2 area varies with an average of 20.22 ± 0.43 . In the rectum, the number of OLU increases from the rectum with an average of 14.42 ± 1.74 . The number of Single Lymphoid Nodules in the blind intestine of irradiated rats averaged 10.02 ± 0.79 . In the middle part of the mesenteric section of the large intestine the number of OLU per 1 mm^2 of the area averages $15,18 \pm 0,55$, in the rectum section of the large intestine the number of Single Lymphoid Nodules increases on average - $17,66 \pm 1,5$.

The study found that the lymphoid plaques of the colon of the first control group have rounded (68.8%), oval (30.1%) and less often atypical (1.1%) shapes. The total area of Grouped Lympho nodules is 5.06% of the total area of the colon at 3 months of age.

Grouped Lymph nodes are located along the antimesenteric wall of the colon and their number throughout the intestine varies from 7 to 13, with an average of 10.0 ± 0.2 . The growth rate of the number of grouped Lymph nodes is 215,0%, which is more than 2,5 times in comparison with newborn rats. In the cecum, the number of Grouped Lymph Nodules ranged from 2 to 3, with an average of 2.5 ± 0.11 , and their sizes ranged from $0.78 \times 0.78 \text{ mm}$ to $2.4 \times 2.4 \text{ mm}$, with an average of $1.3 \pm 0.13 \text{ mm} \times 1.94 \pm 0.14 \text{ mm}$. The number of lymphoid nodules in Grouped Lymph Nodules ranges from 5 to 6, with an average of 5.4 ± 0.2 . Most of the lymphoid nodules were rounded or oval, rarely quadrangular in shape. The grouped Lympho Nodules were located at a distance from 25 mm to 57 mm, on average - $43,1 \pm 0,3 \text{ mm}$ from each other.

In the colon, 4 to 8 clustered Lymph nodes were found, with an average of 6.0 ± 0.2 , and their size ranged from $0.82 \times 0.82 \text{ mm}$ to $3.0 \times 3.5 \text{ mm}$, with an average of $1.35 \pm 0.3 \text{ mm} \times 2.55 \pm 0.1 \text{ mm}$. The number of lymphoid nodules in Grouped Lymph Nodules increases from 6 to 11, with an average of 8.0 ± 0.2 . The distance between Grouped Lymph Nodules ranged from 16 to 78 mm, with a mean of $49.6 \pm 0.8 \text{ mm}$. No clustered Lymph nodes were found in the rectum of 3-month-old rats.

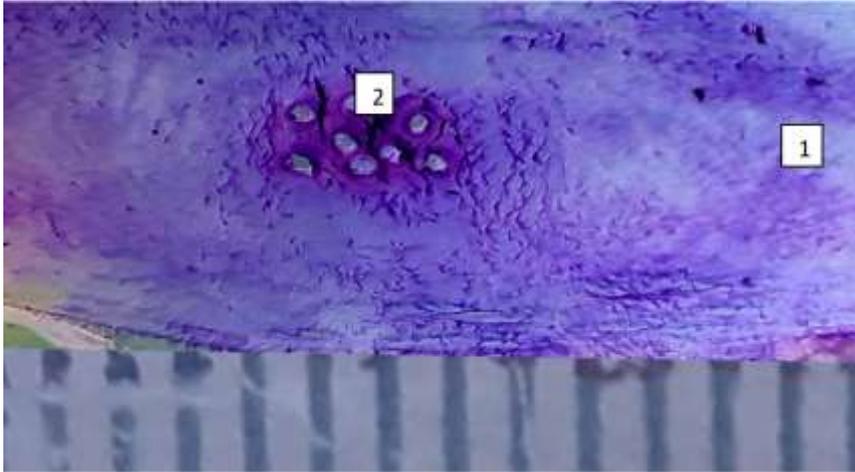


Fig. 3. Aggregated lymphoid nodule of rounded shape of the colon of a 3 x month old rat after irradiation against the background of administration of pure ASD - 2 fraction. (Helman colouring. Eq. 7 times. 1 - colon wall, 2 - lymphoid node of the plaque).

The grouped colon Lymph nodes of the second group have rounded (54.3%) and oval (25.6%), less often quadrangular and irregular shapes (21.1%), the total area of grouped Lymph nodes is 4.03% of the total area of the colon. In the third group, GLU are rounded (63.5%) and oval (27.8%), quadrangular and irregular shaped (8.7%), the total area of Grouped LymphoUnodes is 3.69% of the total area of the colon. In the fourth group, grouped Lymph nodes are rounded (58.2%) and oval (26.5%), less frequently quadrangular and irregular in shape (15.3%), the total area of grouped Lymph nodes is 3.28% of the total area of the colon. A visual confirmation of the obtained parameters is given in (Fig. 3), where the comparative parameters of the following are indicated forms of Grouped Lymph Nodes in the large intestine.

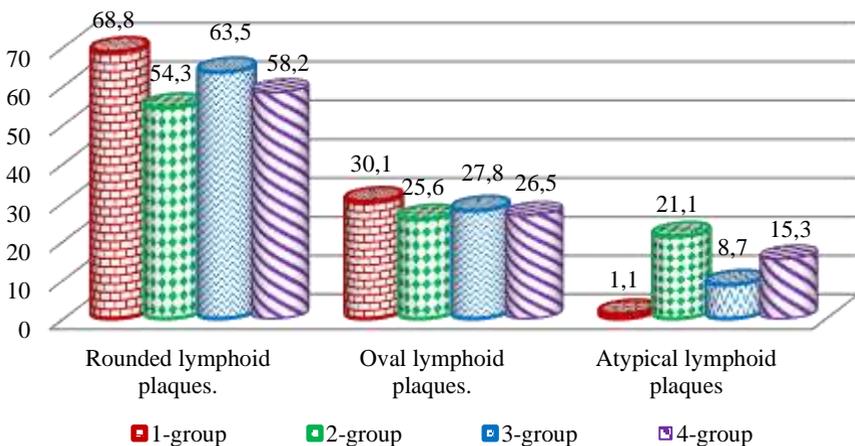


Fig. 4. Ratio of GLU forms in the colon during the experiment in contrast to the control group (in %).

Thus, studies have shown that morphometric parameters of the colon (length, perimeter, thickness) increase unevenly with age.

4 Conclusion

The analysis of literature data shows that, despite numerous studies of domestic and foreign authors devoted to the study of radiation effects on organs and tissues, the influence of the colon on lymphoid tissues is still not fully studied, there are also contradictions within the available data. The development of delicate complexes of disorders in digestive organs under the influence of ionising radiation requires detailed study for prediction and correction of immunological and biochemical changes in the organism.

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