

# CYTOLOGICAL ORGANIZATION OF GASTRIC GLANDS, CRYPTS OF THE SMALL INTESTINE, AND ADRENAL CORTEX IN RATS

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UDC 611.33+611.341+611.451]-018.72

The frequency of distribution of DNA-synthesizing cells in crypts of the small intestine, glands of the gastric fundus, and the substance of the adrenal cortex was investigated in rats from the age aspect. Common features of cytological organization of these organs were: irregularity of arrangement of zones of DNA synthesis and of mitotically dividing cells along the linear structure of the organ; the density of distribution of the features studied in the structure of the organ, depending on the position of the cell and age of the animal; shortening of the zone of mitotically dividing cells in the hepatic column, gastric glands, and intestinal crypts taking place with age.

KEY WORDS: cytological organization; liver; stomach; intestine; adrenal gland.

The trimodal distribution of mitotically dividing and DNA-synthesizing hepatocytes in the hepatic column in rats was demonstrated previously [2, 3] and an age shift of the maxima of these parameters in the direction opposite to the natural movement of the cells in the tissue structure was established.

The same parameters were studied in the present investigation from the age aspect in crypts of the small intestine, glands of the gastric fundus, and the cortical substance of the adrenal gland in rats.

## EXPERIMENTAL METHOD

The small intestine, adrenal gland, and stomach were investigated in 28 male rats aged from 1 to 21 months. A segment of small intestine at the level of the flexure and the first Peyer's patch, an area of the body of the stomach at the level of its middle, and the adrenal glands were taken for histological investigation. Material was fixed in 10% neutral formalin, after first irrigating the lumen of the stomach and intestine with 5% formalin cooled to 4°C. The most contracted regions of the intestine were taken for embedding in paraffin wax. Sections through the adrenal were cut at the point of maximal diameter. Sections 5-6  $\mu$  thick were stained with Meyer's hematoxylin. The distribution of mitoses in enterocytes of the intestinal crypt was established from photomicrographs of the crypts. Numeration of the cell positions in the crypt was fixed in the direction of their natural migration: from the base of the crypt to the villus [4]; the first cell position was taken to be the site of the enterocyte at the base of the crypt, dividing the latter into two symmetrical parts. The distribution of mitoses in glands of the gastric fundus and in the adrenal cortex was established by microscopic investigation of histological preparations. The cell position in the gastric band were numbered in the same way as in the crypt, and cell positions in the adrenal cortex were numbered starting from a cell lying beneath the capsule of the gland, and thereafter along the column toward the medulla. To establish the distribution of DNA-synthesizing cells in the linear structure of these three organs, thymidine- $^3\text{H}$  dissolved in physiological saline was injected intraperitoneally into the rats in a dose of 0.5  $\mu\text{Ci/g}$  body weight (specific activity 21.4 Ci/mmmole). The animals were killed 1 h after injection of thymidine and histoautoradiographs were prepared from their test organs by the standard method [1]. The distribution of DNA-synthesizing cells in the organs was determined in linear structures of the tissue, the cell positions being numbered in the same way as those for determining the distribution of mitoses. The results of counting the parameters were pooled for each cell position from several animals and plotted as histograms, on which cell positions in the tissue struc-

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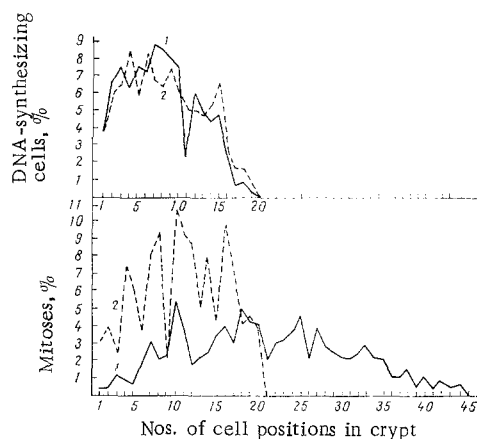


Fig. 1

Fig. 1. Distribution of frequency of DNA-synthesizing cells and mitoses in rats aged 1 month (1 and 1' respectively) and 21 months (2 and 2' respectively) in crypt of small intestine.

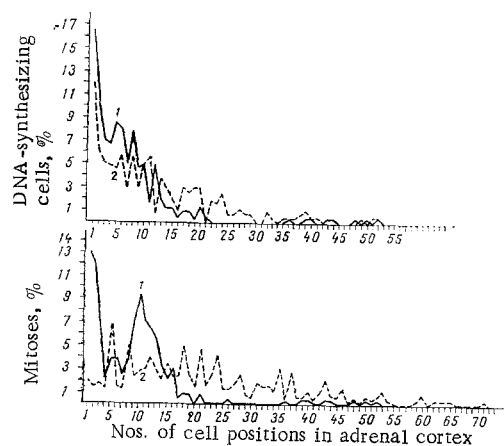


Fig. 2

Fig. 2. Distribution of frequency of DNA-synthesizing cells and mitoses in rats aged 1 month (1 and 1' respectively) and 18 months (2 and 2' respectively) in adrenal cortex.

ture of the organ were plotted along the horizontal axis and the frequencies of the parameters determined for each position, expressed as percentages of the total for that feature, along the vertical axis.

#### EXPERIMENTAL RESULTS

The distribution of the frequency of mitoses and of DNA-synthesizing cells along crypts of the small intestine in rats aged 1 and 21 months is shown in Fig. 1. The frequencies of mitoses were irregularly distributed along the crypt: in young rats the first distinct maximum corresponded to cell position 7, whereas in the old rats it was shifted toward the base of the crypt to position 4. A definite order was observed in the rise and fall of the frequency of mitosis with an interval of 2 or 3 cell positions. In rats aged 1 month the zone of mitosis occupied 44 cell positions, and in the course of 20 months of life it was shortened by 20 cell positions. The width of the zone of synthesis remained unchanged from the 1st to the 21st months and occupied 19 initial cell positions in the crypt, in agreement with data obtained by other workers [4].

The distribution of the frequency of mitosis and of DNA-synthesizing cells in the adrenal cortex of rats aged 1 and 18 months is illustrated in Fig. 2. The distribution of mitoses in rats aged 1 month had two maxima: in the regions of cell positions 1-2 and 10. In these sites mitoses were 3.5 times more numerous than at the minimum in the region of positions 5 and 15. The frequency of mitoses in the old rats in the region of the maximum was only half that in rats aged 1 month. The zone of DNA synthesis occupied 53 cell positions (in preparations with 400-450 DNA-synthesizing cells). In the young rats the course of the curve of DNA synthesis along the structure repeated that of the distribution of mitoses at the beginning of the cell column (positions 1-7) and at its end (after cell position 35). A gradual decrease was observed in the frequency of DNA-synthesizing cells from 16.5% in cell position 1 to 0.5% in position 50. Alternation of maxima and minima of these parameters in the young rat occurred at intervals of one or two cells as far as cell position 22, but in the old rats as far as cell position 30, after which only solitary cells could be found in mitosis or even DNA synthesis.

The distribution of mitoses in the gastric glands of rats aged 2 months was marked by a gradual increase in the frequency of mitoses from the base of the glands to the first significant maximum in cell position 16 and the next two maxima in cell positions 21 and 27 of the glands. The maximum of the density of arrangement of DNA-synthesizing cells corresponded to the above-mentioned position. In the old animals the peaks were shifted toward the base of the gland to positions 18 and 21, and the small peak above position 5 disappeared.

To summarize these results it can be concluded that crypts of the small intestine, gastric glands, and the substance of the adrenal cortex, like the liver which was investigated previously [2, 3], are characterized by a specific spatial distribution of the frequency of mitoses and of DNA-synthesizing cells.

Common features of the cytological organization of the above-mentioned organs from the age aspect are: irregularity of distribution of zones of DNA synthesis and mitotically dividing cells along the linear structure of the organ; density of these parameters in the linear structure of the organ, determined by cell position in the tissue and the animal's age; shortening of the zone of mitotically dividing cells in the hepatic column, gastric glands, and crypts of the small intestine in rats taking place with age.

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