AGE CHANGES IN THE MITOTIC INDEX IN VARIOUS ORGANS OF ALBINO RATS

Yu. A. Romanov, S. M. Kremli, and A. N. Blokhina

UDC 612.65'6:612.014.3

The intensity of cell division in the epithelium and stroma of the thyroid and the epithelium of the parathyroid, the anterior lobe of the pituitary, and the small intestine of male albino rats decreases with age. The period of sexual maturation of the animals is accompanied by an increase in cell division in the endocrine glands and, irregularly, in the epithelium of the small intestine.

* * *

The study of mitotic division from the age aspect is important for understanding the principles governing growth of the organs and the behavior of cell renewal in them at different periods of ontogenesis.

Age changes in the number of mitoses in the epithelium and stroma of the thyroid, and in the epithelium of the adenohypophysis, parathyroid gland, and small intestine of rats were studied in this investigation.

EXPERIMENTAL METHOD

The main series of experiments was carried out on 50 male albino rats of different ages: group 1 – mean weight 5.3± 0.4 g (aged 2 days), group 2 – 29± 0.8 g (aged about 18-25 days), group 3 – 91± 10 g (aged

TABLE 1. Changes in MI (in %) in Organs of Albino Rats with Age (M±σ)

Group of animals	Thyroid epithelium	Thyroid stroma	Parathyroid epithelium	Epithelium of adenohypophysis	Intestinal epithelium
1	0.130± 0.075	0	2,498± 1,567	—	50.8± 7.8
2	0.038± 0.034 P_1=0.029	0	0,536± 0,434 P_1=0,047	0,274± 0.098	29,7± 4,1 P_1=0,001
3	0,144± 0.239 P_2=0,048	0,015± 0,027	0.665± 0.405 P_1=0,028	—	28.6± 4.9 P_1 — ∞
3(a)	—	—	—	0,330± 0.327 P_2=0.045	—
4	0.627± 0.337 P_1=0,006 P_2=0.002 P_3=0,003	0.235± 0.121 P_3=0.001	0.426± 0.431 P_1=0.035	0.300± 0,110	26,9± 2.2 P_1 — ∞
5	0.005± 0.009 P_1=0.009 P_2=0.050 P_3=0.030 P_4=0.003	0	0.065± 0.046 P_1=0.027 P_2=0,042 P_3=0.019 P_4=0.048	0.020± 0 024 P_2=0,002 $P_{3(a)}$=0,048 P_4=0,008	25,4± 3.7 P_1 — ∞
6	0	0	0,129± 0.057	0.009± 0.010 P_2=0,002 $P_{3(a)}$=0.049 P_4=0,006	23,8± 3,4 P_1 — ∞ P_2=0.037

Note. Here and in Table 2 the subscripts attached to P(1, 2, etc.) denote the level of significance of the result relative to the group indicated by the same number in the table.

Department of General Biology, N. I. Pirogov Second Moscow Medical Institute (Presented by Academician of the AMN SSSR V. D. Timakov). Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 67, No. 4, pp. 104-107, April, 1969. Original article submitted February 5, 1968.

TABLE 2. Changes in MI (in %) in Organs of Albino Rats with Age ($M \pm \sigma$)

Group of animals	Thyroid epithelium	Thyroid stroma	Parathyroid epithelium	Epithelium of adenohypophysis	Intestinal epithelium
Series A					
1	0.049±0.021	0.013±0.018	1.494±0.093	0.088±0.065	32.6±5.3
2	0.824±0.423	0.212±0.142	2.150±1.049	0.330±0.099	41.4±1.4
	P_1=0.004	P_1=0.013	P_1=0.333	P_1=0.014	P_1=0.008
Series B					
1	0.060±0.019	0	—	—	27.2±6.0
2	0.625±0.337	0.235±0.121	—	—	26.9±2.2
	P_1=0.003				
Series C					
1	0.008±0.013	0	1.000±0.600	—	21.5±3.3
2	0.900±0.672	0.425±0.283	0.390±0.311	—	26.4±4.6
	P_1=0.003		P_1=0.077		P_1=0.046

Note. Here and in Table 1 the subscripts attached to P (1, 2, etc.) denote the level of significance of the result relative to the group indicated by the same number in the table.

45-50 days), group 3a – 119±9 g (aged 55-60 days), group 4 – 148±8 g (aged 70-75 days), group 5 – 227±18 g (aged 120-130 days), group 6 – 287±49 g (aged 250-270 days).

Organs of 32 male albino rats of different ages were investigated in three additional series. Series A: group 1 – mean weight 94±29 g (aged about 45-50 days), group 2 – 115±23 g (aged 55-60 days); series B: group 1 – 98±7 g (aged 45-50 days), group 2 – 148±8 g (aged 70-75 days); series C: group 1 – 92±4 g (aged 45-50 days), group 2 – 188±15 g (aged 90-100 days).

The animals were sacrificed at 9-10 A.M. Cell division in the organs was estimated by calculation of the mitotic index (MI).

MI of the thyroid epithelium was calculated per 40-60 thousand thyroid cells in each case. MI of the connective-tissue cells of the thyroid stroma was calculated per total number of thyroid cells examined. MI of the parathyroid epithelium was determined per 4-7 thousand cells, MI of the epithelium of the anterior pituitary per 50-60 thousand cells, and MI of the epithelium of the small intestine in 50 longitudinally sectioned crypts (4.5-5 thousand cells) of each animal.

EXPERIMENTAL RESULTS

Thyroid epithelium. As Table 1 shows, MI of the thyroid cells of animals aged 18-25 days was lower than in the gland of rats aged 2 days. With the onset of puberty (weight of rats 199 g) MI increased, and later it fell sharply.

Thyroid stroma. Mitoses were observed in the connective-tissue cells of the thyroid stroma only of animals which had reached sexual maturity (Table 1, groups 3 and 4).

Parathyroid epithelium. MI of the parathyroid cells was much higher in the animals of nearly all age groups (except group 4) than MI of the thyroid epithelium and adenohypophysis of the same animals. MI was approximately 5 times less in the parathyroid of rats aged 18-25 days than in animals aged 2 days, but it remained unchanged throughout the period of sexual maturity, diminishing after its end.

Adenohypophysis. MI of the gland cells of the anterior lobe of the pituitary remained practically unchanged in the animals of groups 2, 3a, and 4. It fell sharply in adult and aging animals.

Small intestine. The highest value of MI was observed in the intestine of animals aged 2 days. In rats of other age groups, MI of the intestinal epithelium was lower than in the animals of group 1, but the difference between the groups was very slight.

If, therefore, the levels of cell division are compared at the two extremes, the general conclusion can be drawn that in adult and aging animals mitotic proliferation in all the organs studied was lower in its intensity than at the beginning of postnatal development. The decrease in cell proliferation in the endocrine organs with age was more marked than in the epithelium of the small intestine.

In the period of puberty, cell proliferation increased in intensity in the thyroid epithelium and stroma, but in the cells of the parathyroid and adenohypophysis the level of mitotic proliferation at this period of ontogenesis was relatively high.

Stimulation of cell division in the period of puberty evidently is not the result of a temporal shift in mitotic activity associated with the 24-hour cycle of mitosis, because at least in the thyroid of rats of different ages, as the observations showed, no increase in MI was observed from 8 to 10 A.M.

The results of the additional series of experiments given in Table 2 confirm the influence of sexual maturity on the age dynamics of cell division in the body. In animals which have reached sexual maturity cell division in the epithelium and stroma of the thyroid and in the epithelium of the adenohypophysis is increased. Stimulation of cell division at this time may also occur in the epithelium of the small intestine (series A and B), but it is found irregularly. There are reports in the literature of an increase in the intensity of cell division in the epidermis of albino mice at the time of puberty [2].

Although it follows from data presented by Alov [1] that male sex hormones inhibit cell division, the changes taking place in the endocrine and other systems of the body at puberty evidently have a more complex influence on the pattern of cell proliferation in the body, which is intensified at this stage of ontogenesis.

LITERATURE CITED

1. I. A. Alov, Outlines of Physiology of Mitotic Cell Division [in Russian], Moscow (1964).
2. J. M. Ortiz-Picon, Z. Zellforsch., 19, 488 (1933).