

DIURNAL RHYTHM OF MITOTIC DIVISION OF CHICKEN THYMUS LYMPHOCYTES

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The existence of a diurnal rhythm of mitoses of the thymus lymphocytes has been found in chickens three weeks old. Maximal mitotic activity of lymphocytes of the cortex and medulla is observed at 6 a.m. and minimal at 12 noon.

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A diurnal rhythm of mitoses in the epithelial tissues has been demonstrated for many organs. As regards lymphoid tissue the problem is not yet solved. A diurnal rhythm of mitoses in some lymphoid organs (thymus, lymph glands, spleen) in cats was discovered as long ago as in 1924 [7]; these findings have been confirmed by investigation of the diurnal rhythm of mitoses in thymus lymphocytes of rats and mice [1, 2]. However, some workers [3, 6], who studied mitotic activity of lymphocytes in lymph glands of rats and mice, failed to find a diurnal rhythm of cell division in these organs.

The object of this investigation was to study the diurnal rhythm of mitotic division of lymphocytes in the cortex and medulla of the chicken thymus.

EXPERIMENTAL METHOD

Experiments were carried out on 68 chickens aged 3 weeks and weighing 140-160 g. The experiments were carried out in Leningrad and Tartu on April 2 and 3, 1963 (series I), on April 17, 1965 (series II), and April 13 and 14, 1966 (series III). At these times of year the length of the periods of light and darkness in these cities are practically equal. The chickens were sacrificed at intervals of 3 h during the 24 h period. Material was fixed in Brank's and Maximow's fluids. Paraffin sections were cut to a thickness of 7 μ and stained with hematoxylin-eosin, azure II-eosin, and Heidenhain's iron hematoxylin. Mitoses (objective 90, ocular 1.5 \times 7) were counted in preparations stained by Feulgen's method. The number of mitoses was determined in 6000 cells in the cortex and medulla of the lobules and mitotic index (MI) was calculated as the number of mitoses per thousand cells. The numerical results were analyzed statistically by the methods of Fisher and Weber.

EXPERIMENTAL RESULTS

In all series of experiments MI of the cortical lymphocytes of the thymus reached a maximum at 6 a.m. (Fig. 1), when it differed significantly from its values at all other times of observation ($P < 0.001$).^{*} In the medulla the changes were similar but less marked ($P < 0.001-0.02$). The maximum of mitotic activity of the cortical leukocytes was 2-4 times, and of the medullary lymphocytes 1.5-2 times greater than the mean data for the 24 h. A second small increase in MI of the cortical lymphocytes was observed in series I and II at 3 p.m. and in series III at 9 p.m. A similar increase in mitotic activity of the medullary lymphocytes was observed in series III only (at 9 p.m.). However, none of these changes were statistically significant relative to adjacent times of observation ($P > 0.05$). The minimal activity of mitotic cell division in the cortex and medulla was observed as a rule at 12 noon (MI of the lymphocytes was then 50-67% of the mean indices for the 24 h).

Our results indicating a diurnal rhythm of mitotic division of chicken thymus lymphocytes are in agreement with those obtained by I. A. Alov [1, 2], who found that the number of mitoses in the thymus of rats per

^{*}In the experiments of series III mitoses were counted in coded preparations.

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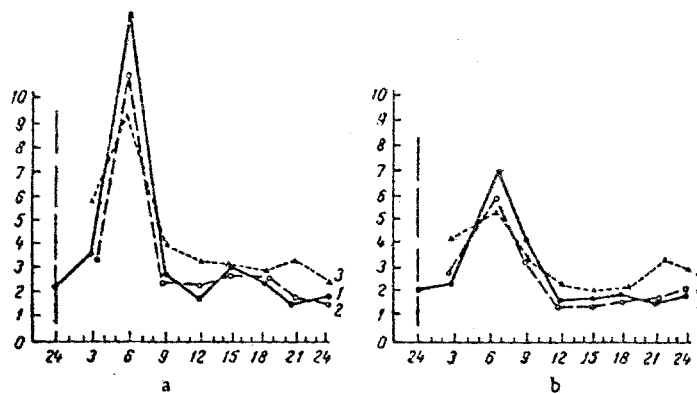


Fig. 1. Dynamics of diurnal changes in mitotic activity of cortical (a) and medullary (b) lymphocytes of the thymus in chickens. Abscissa: time of day (in h); ordinate: MI (promille). 1) Experiments of series I; 2) series II; 3) series III.

conventional unit area of section ($1.65 \mu^2$) was 117 ± 16 at 6 a.m. and 68 ± 90 at 6 p.m. ($P=0.04$). The results of our own experiments on rats [5] show that MI of cortical and medullary lymphocytes of the thymus reaches a maximum also at 6 a.m. (on the first day of investigation 9 ± 0.9 and 3.8 ± 0.3 respectively, on the second 8.5 ± 0.8 and 3.9 ± 0.4), while the number of lymphocytes reaches a minimum at 12 noon. Hence, the results obtained on rats and chickens agreed completely.

The results of our investigations do not agree with those obtained by Bullough [6] and Yu. K. Bogoyavlenskii [3], who found no diurnal rhythm of mitoses in the lymph glands of rats and mice. This may be because the authors cited counted mitoses under comparatively low power (objective 40, ocular 7). Other authors [4] also deny the existence of a diurnal rhythm of mitoses in the hemopoietic organs of rats. The negative conclusions drawn from these investigations are probably attributable to an unhappy choice of times of investigation (10:30 a.m., 1:30 p.m., 4:30 p.m., 9:30 p.m., 3:30 a.m., and 10:30 a.m.), because MI reaches its maximum at 6 a.m. [1, 5]. It should also be mentioned that a mitotic rhythm has been observed in human bone marrow [8].

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