

THE DIURNAL RHYTHM OF MITOTIC ACTIVITY IN CERTAIN  
TISSUES OF YOUNG WHITE RATS

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The results of studies of mitotic activity in fetuses and young animals are somewhat conflicting. Whereas certain research workers have observed a diurnal rhythm of mitotic activity in the fetus before parturition and have found it to be synchronous with the maternal rhythm [3], others have either failed to observe any rhythm in cell multiplication [5] or found that what rhythm occurred did not synchronize with the mitotic rhythm of the mother [4].

In a previous work [4], we have investigated the mitotic activity in cells of the cornea and the glomerular zone of the adrenal glands, in one day old rats and in rat fetuses one day before parturition. The present work is concerned with a study of the diurnal periodicity of division among cells of the corneal epithelium and the adrenal cortex in 7 and 17 day old rats and in their mothers.

#### EXPERIMENTAL METHODS

The experiments were conducted on rats of the Wistar strain. In the first series of experiments we investigated tissues from 7 day old rats and in the second series from 17 day old rats ( $1\frac{1}{2}$ -2 days after opening of the eyes). Mitotic activity of the adult females was investigated in both the first and the second series. The rats were kept under conditions of natural illumination and given free access to food. During the period of the experiment the female rats were lactating and suckling the young. The animals were killed by decapitation at intervals of three hours throughout the 24 h period. At each time interval we investigated 2-3 females and 4-5 baby rats belonging to each female. The material for examination was fixed in Carnoy's fluid and embedded in paraffin wax; sections were cut at a thickness of  $7\ \mu$  and these were stained in hematoxylin. Total preparations of the corneas were prepared.

Mitotic activity was determined in the cornea and in the glomerular zone of the adrenals and the mitotic coefficient (MC—i.e., the number of mitoses per 1000 cells) was then calculated. The mitotic activity determinations in the adrenals was based on 6000-8000 cells, in the cornea on 11,000 cells in every case.

#### RESULTS

Corneal epithelium. In the cornea of the female rats, 7 and 17 days after they had given birth, a similar diurnal rhythm of cell division was observed to that found in normal adult rats [1]. In both cases the diurnal periodicity of mitosis could be represented by a curve with a single peak. In adult females, seven days after they had given birth, the maximum number of mitoses was found to occur between 7 and 10 h (MC = 12.3%) and the minimum number between 19 and 4 h (MC = 5.6%; P = 0.02-0.002). Seventeen days after the rats had given birth, the maximum number of mitoses occurred between 1 and 7 h (MC = 10.7-12.4%) and the minimum between 16 and 22 h (MC = 6.9-7.7%; P = 0.04).

It is interesting to find that the daily mean mitotic activity of females 7 days (8.9%) and 17 days (9.1%) after they have given birth is considerably lower than the day before parturition (14.2%) and is of the same order as occurs in normal adult rats.

In 7 day old rats (Fig. 1) the mitotic activity remains at the same level throughout the 24 h period, and only at 4 h does the number of cell divisions show any significant reduction as compared with the previous period (P =

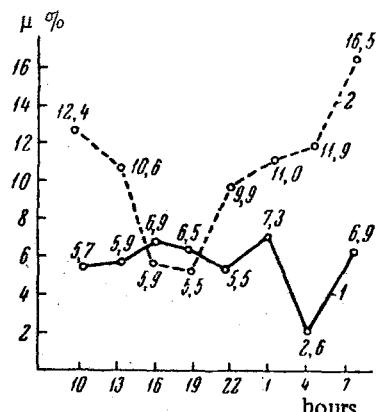


Fig. 1. Curve showing diurnal changes in the mitotic activity of corneal epithelium in 7 and 17 day old rats. 1-7 day old rats: 22 and 1 h,  $P = 0.0001$ ; 1 and 4 h,  $P = 0.001$ ; 4 and 7 h,  $P = 0.001$ ; 2-17 day old rats: 13 and 16 h,  $P = 0.002$ ; 19 and 22 h,  $P = 0.005$ ; 4 and 7 h,  $P = 0.02$ .

Mitotic Coefficient (as %) in the Glomerular Zone of the Adrenal Gland of Female Rats 7 and 17 Days after They Have Given Birth

Time of killing (hour of day)	7 days after giving birth	17 days after giving birth
10	0.00	0.04
13	0.04	0.27
16	0.09	0.11
19	0.50	0.00
22	0.06	0.00
1	0.45	0.21
4	0.23	0.04
7	0.00	0.03
10	0.04	0.03

It is evident from the table that in females 17 days after they have given birth, the glomerular zone of the adrenal gland is characterized by a curve of mitotic activity exhibiting two peaks. A considerable number of mitoses occur at 13 h ( $MC = 0.27\%$ ) and at 1 h ( $MC = 0.21\%$ ) and the minimum number is associated with the 4-10 h period ( $MC = 0.03-0.04\%$ ) and the 19-22 hour period ( $MC = 0$ ). These differences are statistically significant ( $P = 0.02-0.03$ ).

In the glomerular zone of the adrenal gland in 7 day old rats (Fig. 2) the number of cell divisions shows a significant reduction at 19 h ( $P = 0.01$ ) and undergoes subsequent increase until 1 h ( $P = 0.01$ ). The daily mean mitotic activity in 7 day old rats (6.9%) is 40 times greater than in their mothers (0.17%).

A considerable number of mitoses may be observed in the adrenal glomerular zone of 17 day old rats at 10, 22, and 4 h and a low mitotic activity at 13, 16, 1, and 7 h. These changes in the number of cell divisions are statistically significant ( $P = 0.03-0.001$ ). The daily mean mitotic activity (6.2%) is almost 70 times greater than in their mothers (0.09%).

It follows that the diurnal rhythm of mitotic activity in the adrenal glands of 7 and 17 day old rats is different from that found in their mothers and is also different from that previously observed in adult rats [2]. The curve

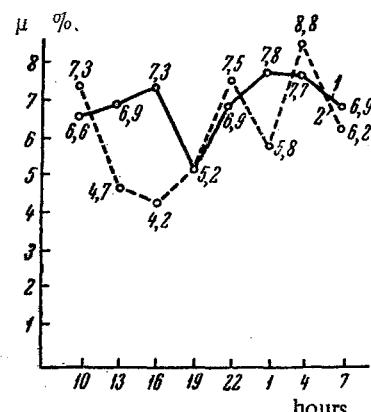


Fig. 2. Curve showing diurnal changes in the mitotic activity of the glomerular zone in the adrenals of 7 and 17 day old rats. 1-7 day old rats: 16 and 19 h,  $P = 0.01$ ; 19 and 1 h,  $P = 0.01$ ; 2-17 day old rats: 10 and 13 h,  $P = 0.01$ ; 22 and 1 h,  $P = 0.02$ ; 1 and 4 h,  $P = 0.002$ ; 4 and 7 h,  $P = 0.03$ .

0.0001). However, by 7 h the number of mitoses has increased again  $P = 0.001$ ). The daily mean mitotic activity is 6%.

The diurnal rhythm of mitosis in 17 day old rats (see Fig. 1) exhibits a single maximum between 7 and 10 h. The minimum number of mitoses occurs between 16 and 19 h. The daily mean activity (10.3%) approximates to that observed in adult rats.

Adrenal glands. The curve of diurnal mitotic periodicity in the glomerular zone of the adrenal gland (c.f. table) in female rats 7 days after they have given birth is similar to that characteristic of normal rats [2]. The only difference lies in the circumstance that at 22 h the number of cell divisions is low. Considerable mitotic activity is observable at 19 h and at 1 h, and the minimum number of mitoses is associated with 7, 10, and 13 h. However, none of the differences are significant ( $P = 0.04-0.4$ ) and this may be due to the small number of animals examined at any one time.

showing the diurnal mitotic rhythm of the cells associated with the glomerular zone of the adrenals in lactating females is also different from that for normal rats in having two peaks. It is interesting to find that, among rats examined during the period of lactation, the mitotic activity of the adrenal glomerular zone was low (0.17-0.09%). A considerable volume of mitotic activity was noticed in the glomerular zone of the adrenals in 17 day old rats at 22 h, but the nature of the curve in rats at this age differed from the normal curve of diurnal mitotic activity in certain respects.

We have, therefore, found that in the cornea of 17 day old rats (which have lived for 1½-2 days with their eyes open) the diurnal rhythm of mitotic activity is similar to that in adult rats. It is possible that light is an influence in establishing the rhythm of mitotic activity in the corneal epithelium. In the glomerular zone of the adrenal gland, it has proved impossible to detect any diurnal rhythm of mitosis during the first 17 days of life. Further investigations are needed to elucidate this problem.

#### S U M M A R Y

A study was made on the diurnal rhythm of mitotic activity in the glomerular zone of the adrenal gland and in the corneal epithelium in 7 and 17 day old rats and their mothers respectively. It was found that the diurnal rhythm of mitoses in 7 and 17 day old rats and their mothers respectively in the glomerular zone of the adrenal was not identical. On the other hand, it was noted that the diurnal rhythm of mitoses in the glomerular zone in the lactating females under investigation also differed from the rhythm noted in normal adult rats.

By the 17th day, a diurnal mitotic rhythm similar to that in adult animals was established in the corneal epithelium.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. Some or all of this periodical literature may well be available in English translation. A complete list of the cover-to-cover English translations appears at the back of the first issue of this year.

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