

EXPERIMENTAL BIOLOGY

DIURNAL RHYTHM OF MITOTIC ACTIVITY IN CERTAIN FETAL TISSUES AND ONE-DAY-OLD RATS

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Most experiments in the study of the diurnal periodicity of cell multiplication have been carried out on mature animals [1-4]. Meanwhile it is very important to investigate the development of the periodicity of mitotic activity during ontogenesis.

N. V. Krasil'nikova [5] showed that the diurnal rhythm of mitotic activity of 22-day-old fetuses of mice and rats is synchronous with the corresponding rhythm of the mother. She hypothesized the stability and inheritability of the diurnal rhythm of mitoses.

The purpose of the present work was to study the diurnal periodicity of cell division in the epithelium of the cornea and adrenal of fetuses one day before birth, in one-day-old rats, and in the mothers.

METHOD

Two series of experiments were carried out. In the I series we investigated the tissues of pregnant rats and the fetuses one day before birth and in the II series the females and one-day-old rats. We used randombred white rats which were housed under natural illumination and had free access to food. The animals were decapitated during the course of the day at 3 h intervals. At each period we investigated three females and four fetuses or an infant rat from each of them. The material was fixed in Carnoy's mixture, embedded in paraffin, sections 7 μ thick were stained with hematoxylin after Caracci. Wholemounts were prepared from the cornea.

We determined the mitotic activity in the cornea and in the glomerular zone of the adrenal, we calculated the mitotic index—the number of detected mitoses per 1000 cells. The mitotic activity in the adrenal was determined on 4,875 cells and in the cornea on 6000-8000 cells.

RESULTS

A diurnal rhythm of cell division was detected in the cornea of the pregnant females a day before giving birth (Table 1). It can be expressed as a 1-peak curve with a maximum number of divisions at 4-7:00 A.M. and a minimum at 10:00 P.M.-1:00 A.M. ($P = 0.001$). This rhythm proved to be similar to that previously noted in mature normal rats [3].

A relatively high mitotic activity, being lower at 10:00 A.M.-4:00 P.M. than at night and early morning—at 7:00 P.M.-7:00 A.M. ($P = 0.001$), was retained during the 24 h period in the fetuses (Table 2). Thus, a high mitotic activity was observed for fetuses during a longer period than for the females. Furthermore, the time of the minimum number of mitoses did not coincide in these two groups.

The mean daily level of mitotic activity in the cornea of the pregnant female (14.2⁰/100) proved to be 2 times higher than in the cornea of the fetuses (6.8⁰/100).

TABLE 1. Mitotic Index of the Corneal Epithelium of Pregnant Rats and One-Day-Old Rats

Time of fixation	Pregnant females	Females a day after birth	
	Mitotic index (in ‰)		P
10 AM	13.4	13.8	—
1 PM	13.3	10.6	0.01
4 PM	9.4	20.2	0.06
7 PM	10.2	9.9	—
10 PM	7.9	8.2	0.028
1 AM	6.8	17.0	0.2
4 AM	16.1	11.5	0.2
7 AM	24.9	17.4	

TABLE 3. Mitotic Index of the Glomerular Zone of the Adrenal of Fetuses and One-Day-Old Rats

Time of fixation	Fetuses	One-day-old rats	
	Mitotic index (in ‰)	Mitotic index (in ‰)	P
10 AM	12.8	3.13	0.0001
1 PM	12.5	5.63	—
4 PM	14.9	3.58	—
7 PM	16.6	3.99	—
10 PM	11.3	3.65	—
1 AM	9.43	3.47	—
4 AM	12.3	3.39	0.06
7 AM	14.9	4.52	

maximal mitotic activity (0.61 ‰) was noted at 10 PM. In the glomerular zone of the adrenal of the fetuses (Table 3) we found a distinct 2-peaked curve with a mitotic maximum at 7 PM and 7 AM ($P = 0.01$ and less). The average daily mitotic index of the fetuses (13.1 ‰) was more than 30 times greater than for the pregnant females (0.39 ‰).

In the glomerular zone of the adrenal of the female a day after birth the diurnal changes in the number of mitoses proved to be the same as for normal rats with a maximal number of mitoses (0.97 ‰) at 10 PM.

TABLE 2. Mitotic Index of the Corneal Epithelium of Fetuses and One-Day-Old Rats

Time of fixation	Fetuses		One-day-old rats	
	mitotic index (in ‰)	P	mitotic index (in ‰)	P
10 AM	5.59	—	3.78	0.01
1 PM	5.52	0.37	2.31	—
4 PM	4.59	0.001	3.49	—
7 PM	7.21	—	4.61	—
10 PM	7.56	0.07	4.28	—
1 AM	6.55	0.002	4.92	0.007
4 AM	8.44	—	2.36	0.007
7 AM	8.68		4.36	

The shape of the curve of the number of mitoses in the corneal epithelium changed for the females a day after birth (see Table 1). In spite of the fact that at each period we fixed material only from three females, a significant increase in the number of mitoses was observed at 4 PM and 1-7 AM ($P = 0.02-0.001$). Thus, the curve of the diurnal rhythm of mitoses proved to be 2-peaked.

The mitotic activity of the one-day-old rats (Table 2) changed during the course of the day. The maximal number of mitoses was noted in the morning, at 7 AM, during the evening and night from 7 PM to 1 AM ($P = 0.004-0.007$), and at 1 PM and 4 AM there occurred a significant drop of mitotic activity ($P = 0.01-0.007$). The average daily level of mitotic activity for the female a day after birth (13.4 ‰) proved to be higher than in the one-day-old rats (3.7 ‰) by a factor of 3.6.

In the glomerular zone of the adrenal of the pregnant rats we found the same regularity of the diurnal mitotic activity as in normal rats [4]. The

In the one-day-old rats (see Table 3) we observed only one significant increase in the number of mitoses at 1 PM ($P = 0.0001-0.01$). The average daily mitotic activity in the glomerular zone of the adrenal of the one-day-old rats (3.8%) proved to be lower than in that of the fetuses (13.1%).

Thus, as the result of these experiments it was established that the diurnal periodicity of cell multiplication of fetuses and the mother and of the one-day-old rats and the mother is not the same either in the cornea or in the adrenal. In the cornea of the fetuses the diurnal rhythm of mitoses was less evident in comparison with the adrenals, for which a 2-peaked curve was obtained at the same periods.

The present study did not confirm the data of N. V. Krasil'nikova [5] on the synchronism of the diurnal rhythm of mitotic activity in the mother and fetus. Birth is probably a stress factor which changes the curve of the diurnal rhythm of mitoses in the cornea of the mother.

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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 this issue.