

Relaxation of Pubic Symphysis of the Mouse during the Estrous Cycle and Pseudopregnancy.* (19820)

BERNARD KLIMAN AND HILTON A. SALHANICK.† (Introduced by Frederick L. Hisaw.)

From the Biological Laboratories, Harvard University, Cambridge, Mass.

In the course of recent investigations on the role of the relaxative hormone in the mouse(1-3), a study was made of its possible significance during the estrous cycle and pseudopregnancy. Previously, Gardner(4) had found that the pubic symphysis of the male mouse remains cartilaginous but, in the female, the cartilage is replaced by an interpubic ligament at sexual maturity. This sexual dimorphism, due to the action of estrogen, could be prevented by castration. It has also been found that during pregnancy the pubic bones of the mouse begin to separate on about the 13th day and reach a maximum by the 19th day, the rate of separation being about one millimeter per day(5). Castration and destruction of the fetuses prevented this separation(6). In the castrated mouse, estrogen could not reproduce the separation seen in pregnancy while combinations of estrogen and an extract of pregnant rabbit serum (PRS) did. Therefore, Hall and Newton(5,7) concluded that pubic separation occurring during pregnancy is caused by relaxative hormone.

In this study, x-ray measurements of the separation of the pubic bones were made during various stages of the estrous cycle and during pseudopregnancy.

Materials and Methods. Three separate groups of mature, virgin mice were studied at different times (Table I). Vaginal smears were taken from each mouse, dried, fixed in methanol and stained in 0.05% Giemsa solution. The cellular contents of these smears were evaluated and each of the mice was recorded as being in estrus, metestrus, diestrus, or pro-estrus, according to the classification of Snell(8). Immediately before the vaginal smears were taken, x-ray photographs were

taken of the pubic symphyses and the separations were measured by a technic already described(2). A total of 162 mice were used for this part of the study. Another group of 14 mice was made pseudopregnant by stimulation of the uterine cervix during estrus with a faradic current of five volts. Three days later, the uteri of 9 of these mice were traumatized with a thread to produce a decidual reaction. All mice were x-rayed several times during the course of pseudopregnancy and vaginal smears were taken daily to verify that they were pseudopregnant.

Results. During estrus, there is a small but definite relaxation of the pubic symphysis (Table I). In each of the 3 experiments, the average separation of the symphysis during estrus was larger than the average separation at any other time in the cycle, and when the total results were averaged it was found that the average separation of 0.43 mm in 70 estrous mice was approximately twice that which occurred in the other mice during diestrus, proestrus or metestrus. A statistical analysis of these data verified that the differences were highly significant with a P value of less than 0.005. Of the 14 mice stimulated during estrus and thereby made pseudopregnant, none demonstrated a significant change in the separation of the pubic symphysis. The change found after 12 days of pseudopregnancy was 0.04 ± 0.03 mm (mean $\pm$ standard error) for the control mice indicating that pseudopregnancy did not effect a separation of the pubes. Similar measurements for the mice whose uteri had been traumatized showed a change of 0.01 ± 0.02 mm. Therefore, traumatization of the uterus, with the resultant production of deciduomata, also had no effect on the separation of the pubic bones.

Discussion. The pubic symphysis of the normal mouse shows an increased separation during estrus. The magnitude of this separation is such that it cannot be due to the presence of estrogen alone. For example,

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† Present address: University of Utah School of Medicine, Salt Lake City.

TABLE I. Separation of the Pubic Symphysis of the Mouse During Various Stages of the Estrus Cycle.

Group	No.	Metestrus		Diestrus		Proestrus		Estrus	
		No.	Avg separation (mm)	No.	Avg separation (mm)	No.	Avg separation (mm)	No.	Avg separation (mm)
I	92	11	.17	24	.20	13	.22	44	.40
II	50	5	.14	20	.21	8	.16	17	.35
III	20	2	.60	5	.08	4	.30	9	.69
Totals	162	18	.22	49	.19	25	.21	70	.43

Statistical analysis of averages of total number of animals in each group by "Student's" t test verified that differences between average of the estrous group and each of the other groups were highly significant (P values less than 0.005). Standard error for the estrous group is ± 0.05 and for the other groups less than ± 0.01 in each case.

after 8 to 10 days pretreatment with 1 μ g estradiol daily, the separation in castrated mice is found to average only 0.03 mm per day for the last 2 days(2). In contrast to this, the increment for estrous mice is 0.22 mm for the day following proestrus (Table I). In castrated mice, after 2 days of estrogen priming an extract of PRS was able to produce an increase in separation of 0.31 mm in the next 24 hours(9). It is of interest that the pregnant mouse may show a rate of separation of 1.0 mm per day(5), and this rate can be duplicated experimentally only by the administration of estrogen and PRS extracts(2,7). Thus it appears that the phenomenon of relaxation during estrus as well as during pregnancy is caused by the combined action of estrogen and a relaxative hormone.

The fact that relaxation does not occur in the pseudopregnant mouse even in the presence of deciduomata does not conclusively verify the absence of a hormone of relaxation. Hall and Newton(5) have shown that even the pregnant mouse does not relax during the first 13 days of pregnancy. They have also found(10), and we have confirmed that progesterone prevents the occurrence of pelvic re-

laxation in mice treated with estrogen and extracts of PRS.

Summary. X-ray photographs were taken of the pubic symphyses of mice at various stages of the estrous cycle and the separations of the pubic bones were measured. Significant relaxation occurred during estrus. No change in separation could be detected during artificially induced pseudopregnancy even when the uteri were stimulated to produce deciduomata.

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