

THE EFFECT OF BILATERAL OVARIECTOMY AND TREATMENT WITH SEX HORMONES ON THE AMYLASE ACTIVITY IN BLOOD AND PANCREAS OF FEMALE ALBINO RATS

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The estrogenic hormones, generally considered as „growth factors“ with effect mainly upon the primary and secondary sex organs, exert influence also on a number of basic processes in the organism: tissue respiration, energy metabolism, metabolism of carbohydrates, fat and protein metabolism, water-salt balance (12). The multifateral functions of estrogens and of other hormones as well, however, occurs in the periphery, in enzymic systems, and our knowledge on the regulation of these processes is still rather limited (6).

In previous works by the same authors (2, 3), the influence of androgenic hormones on the activity of the amylase in the blood and pancreas of male rats was studied. In the present paper the authors set themselves the task of investigating the influence of estrogenic hormones upon the activity of amylase in castrated and intact female rats.

Method

The studies were carried out on five series white albino female rats, weighing from 170 to 210 gr, as follows: I series — controls (18 rats); II series — ovariectomized (16 rats); III series — intact, injected with estradioldipropionate (11 rats); IV series — ovariectomized, injected with estradioldipropionate (10 rats) and V series — ovariectomized, injected with testosteronepropionate (9 rats).

The experimental animals of the II, IV and V series were subjected to investigation 5 months after operative excision of the ovaries.

Estradioldipropionate in the form of oil solution was administered intramuscularly during a 7-day period, with daily dose 200 IE per 100 gr body weight. The vaginal smears of the animals treated with the stated dose estradiolpropionate, contained on the 4th day only keratinized epithelial cells with no nuclei— an indication that the animals were in the state of estrus.

The testosteronepropionate, also in oil solution, was injected intramuscularly in a total dose 1 mg per 100 gr body weight, administered three times in the course of 10 days.

The test animals were sacrificed by decapitation in the same hour of the day (10 a. m.), kept for 15 hours previously without food. The method

of investigation is reported in detail in a previous work by the authors (2). The amylase activity in the blood and pancreatic homogenate was determined according to the method of *Engelhardt-Gerchuk* (18) and *Balzer-Schuster* (9) as modified by ourselves (1, 2).

Results

The arithmetical means of the results obtained and their standard errors during the investigation of five series white female rats are demonstrated in tables 1 and 2.

Table 1

The effect of ovariectomy and treatment with sex hormones on the amylase activity in the blood of female rats

Series of animals investigated	Number of animals	Amylase activity-increase of reduction substances (in mg/ 1 ml blood)		Statistically reliable alteration in % with reference to controls (P=0.05)
I — control, intact	18	74.6	5.50	—
II — ovariectomized	15	53.7	3.87	reduction — 28.3%
III — intact, estradioldipropionate	10	53.4	3.24	reduction — 28.0%
IV — ovariectomized, injected with estradioldipropionate	10	50.64	3.08	reduction — 32.2%
V — ovariectomized, injected with testosteronepropionate	9	54.8	2.30	reduction — 26.5%

Table 2

The influence of ovariectomy and treatment with sex hormones on the amylase activity in pancreatic homogenates of female rats

Series of animals investigated	Number of animals	Amylase activity — increase of reduction substances (in mg/1 mg fresh tissue)
I series — controls, intact	15	18.36 ± 0.61
II " — ovariectomized	16	19.55 ± 0.68
III " — intact, injected with estradioldipropionate	10	16.75 ± 0.80
VI " — ovariectomized, injected with estradioldipropionate	11	19.72 ± 0.85
V " — ovariectomized, injected with testosteronepropionate	10	16.47 ± 1.10

The data in table 1 show a reduction of amylase activity in the blood of all series experimental animals as compared to the activity in the controls. This reduction in the different series is comparatively uniform. It is further noted that amylase activity in the ovariectomized group remains unaltered following injection of estradioldipropionate and testosteronepropionate.

From the data reported in table 2 it is concluded that the activity of pancreatic amylase does not show statistically reliable differences following ovariectomy, neither in the ovariectomized animals treated with estradioldipropionate. A tendency towards reduction is marked in the animals of series III — intact, injected with estradioldipropionate and in series V — ovariectomized, injected with testosteronepropionate.

Discussion

The data obtained (series II) show that amylase activity in the blood of female rats, investigated 5 months after ovariectomy, is lowered with 28,9% as to controls.

This finding could be considered as an expression of reduced amylase synthesis in the rats treated, resulting from estrogenic insufficiency. The effect of estrogens on a number of enzymic systems is well known, namely: glucuronidase, cholinesterase, succindehydrogenase, arginase, hyaluronidase (cited according to 13) — and is being interpreted as activation of the processes of protein and uridindinucleotide synthesis (19, 20, 21).

On the other hand, the removal of the ovaries brings about enzymic and morphological alteration in the hypophysis (11, 12), which as well known, plays an essential role in the regulation processes of protein synthesis.

The experiments with introducing estradioldipropionate into intact female rats (series III) also show a reduction of amylase activity in the blood as compared to controls (28,0%). We could possibly admit that the estradioldipropionate dose chosen by us, and employed in the manner already described by other authors (24) is rather high (12).

There is sufficient evidence proving that high doses estrogenic hormones and prolonged administration result in disturbances, through hypophysis inhibition, of the vegetative-hormonal balance in the organism (10).

The results obtained suggest that the effect of estrogenic hormones on the amylase activity is not direct, being subordinated to the complex hypothalamo-hypophyseal regulation (6). It is possible, by means of changes caused in the hypophysis during castration and sex hormones introduction, to bring about disturbances in the hypothalamo-hypophyseal-adrenal system (4, 16, 17), leading on its turn to altered amylase activity. The participation of adrenal hormones in the regulation of saliva amylase is well known (18), as well as of blood plasma amylase (15).

Proceeding from literature reports on anabolytic effect of estrogens (14, 21) and androgenic hormones (13, 14) and on the ground of personal observations (3) on the effect of testosteronepropionate upon amylase activity in castrated male rats, we carried out the experiments in series IV and V.

In both series the additional treatment of ovariectomized rats with sex hormones did not account for restoration of the lowered amylase activity in blood.

Probably, against the background of the experimental setting herein described, the normal interrelationships are disturbed between the various endocrine glands, having a definite bearing on amylase activity regulation (5, 7, 16, 17). Clarification of these interrelationships is beyond the scope of the present paper.

Of particular interest is the fact that amylase activity in the pancreatic homogenates in the different series of experimental animals, contrary to the changes in blood amylase, does not exhibit statistically reliable alterations (table 2). Very probably, the pancreas displays a stronger resistance to hormonal disturbances therein occurring.

We feel that the evidence herein submitted supports the studies according to which blood amylase is being produced apart from the pancreas, also by other tissues as well (23).

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**ВЛИЯНИЕ ДВУХСТОРОННЕЙ ОВАРИЭКТОМИИ И ВВЕДЕНИЯ
ПОЛОВЫХ ГОРМОНОВ НА АКТИВНОСТЬ АМИЛАЗЫ В КРОВИ
И ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЕ У САМОК БЕЛЫХ КРЫС**

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РЕЗЮМЕ

Авторы исследуют влияние эстрогенных и андрогенных гормонов на активность амилазы в крови и поджелудочной железе овариэктомированных самок крыс. Опыты проведены на 18 контрольных крысах, 16 овариэктомированных, 11 интактных, которым вводился экстрадиолпропионат в дозе 200 IE/100 г веса ежедневно в течении 7 дней, 10 овариэктомированных, которым вводился тестостеронпропионат в общей дозе 1 мг/100 г веса разделенной на три раза в продолжении 10 дней.

Статистическая обработка результатов показывает следующие изменения активности амилазы крови:

1. У овариэктомированных крыс (серия II) — понижение на 28,3% по сравнению с контрольными.

2. У интактных, которым вводился экстрадиолпропионат (серия III) — понижение на 28,0% по сравнению с контрольными.

3. У овариэктомированных, которым вводился экстрадиолпропионат (сер. V) — активность не изменяется в сравнении с серией II, но на 32,2% ниже в сравнении с контрольными.

4. У овариэктомированных, которым вводился тестостерон (серия V) активность энзима тоже не изменяется в сравнении с серией II, но на 26,5% ниже контрольных.

В активности панкреатической амилазы не устанавливают статистически существенных изменений, исключая тенденцию к уменьшению активности в серии III и V.

Допускается, что отмечаемое после овариэктомии и введения половых гормонов понижение активности амилазы является выражением нарушений в гипоталамо-гипофизарно-адrenalовой системе.