

EXPERIMENTAL BIOLOGY

QUANTITATIVE MORPHOLOGICAL CHANGES IN THE GOLDEN HAMSTER OVARY AFTER UNILATERAL OVARECTOMY IN THE EARLY POSTNATAL PERIOD

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Three weeks after right-sided ovariectomy on golden hamsters at the age of 7 days, the remaining left ovary showed compensatory hypertrophy accompanied by more rapid maturation of follicles.

The postnatal ontogenesis of the mammalian ovary is increasingly a subject for research [3, 7-9]. The study of the ovarian response to surgical procedures at an early age is particularly interesting, since most investigations in this field have been undertaken on adult females, in which the sex cycle has become stabilized [1, 2, 5].

The object of the investigation described below was to study the reaction of the golden hamster ovary to unilateral ovariectomy in the early postnatal period of development.

EXPERIMENTAL METHOD

Right-sided ovariectomy was carried out under ether anesthesia on animals aged 7 days weighing 8-11 g. The operation was performed on 12 female golden hamsters, of which seven died in the postoperative period. The ovaries of 7-day hamsters are characterized by the fact that premeiotic synthesis of DNA in the sex cells is already complete, and about 40% of the oöcytes are in the diplotene stage of prophase of meiosis. At the age of 28 days, 21 days after operation, the remaining left ovary was removed under ether anesthesia from the experimental animals and fixed in Carnoy's fluid. Both ovaries were taken from six control animals of the same age, and fixed in the same way. The organ was weighed three times on analytical scales in a small jar containing 70° ethanol. The arithmetic mean value of the three weight readings was calculated. Serial paraffin sections, 5 μ in thickness, were stained with hematoxylin-eosin and with Heidenhain's azocarmine for histological investigation.

The follicles at all stages of development were counted in every 40th section through the ovary of the experimental and control animals, only those follicles whose oöcytes contained a nucleus being taken into consideration. Atretic follicles also were counted, but only if they contained a nucleus or its fragments. For each stage of follicle development (one, two, three, or more layers) the mean diameter (arithmetic mean of two mutually perpendicular diameters) of the oöcyte nucleus, the oöcyte itself, and the follicle was determined.

Statistical analysis of the numerical results was carried out by the Fisher-Student method.

RESULTS

Determination of the weight of the ovaries of the experimental and control animals showed that in hamsters aged 28 days the weight of the residual ovary was 64.7% of the combined weight of the two ovaries

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TABLE 1. Number (n) and Size of Follicles at Various Stages of Ripening in Golden Hamsters of Experimental and Control Groups

Group of animals	Structures investigated	Primordial follicles	Follicles of one layer	Follicles of two layers	Follicles of three layers	Multi-layered follicles	Antral follicles	Corpora lutea
Experimental	Follicle	—	32,110	58,365	92,625	37,040	454,365	570,000
	Oöcyte	7,500	19,443	27,315	39,135	52,223	—	—
	Nucleus	4,500	11,400	13,215	15,960	18,698	—	—
		252,0	40,7	14	12,7	22,8	4,25	3
Control	Follicle	—	34,170	61,800	90,563	130,748	—	—
	Oöcyte	7,550	19,629	29,235	38,663	55,748	—	—
	Nucleus	4,325	12,450	16,670	18,615	20,925	—	—
		282,0	18,75	5,25	9,6	16,6	0,25	—

*Diameter of structures investigated given in microns.

in control animals of the same age. This shows that 3 weeks after right-sided ovariectomy, when performed on hamsters at the age of 7 days, marked hypertrophy of the residual left ovary was present.

Microscopic examination showed that the ovaries of intact animals aged 28 days are in a prepubertal state, as follows: they contain primordial follicles and ripening follicles at all stages of development, but no corpora lutea are present. Counting of the follicles showed that no individual stage of ripening of the follicles was predominant in the ovaries of the intact hamsters. The small number of antral follicles was noteworthy. Graafian follicles were observed in about half of the animals.

Histological examination of the ovaries of the experimental animals showed the appearance of corpora lutea and an increase in the number of antral follicles. In individual sections as many as nine to 11 could be counted.

The comparative quantitative analysis of follicles in the ovaries of the experimental and control animals showed that the mean number of follicles of all stages of development in the residual ovary was increased after ovariectomy (Table 1). The number of follicles of one and two layers in the experimental group was much greater than in the control. Comparison of the groups of multilayered follicles revealed merely a tendency toward an increase in number of those follicles in the experimental group ($P=0.081$). No statistically significant differences were found between the experimental and control material in the group of follicles with three layers ($P=0.264$). So far as the group of primordial follicles is concerned, their number in the experimental group was lower than in the control. However, because of the considerable individual variations, this difference was not statistically significant ($P=0.409$). The dimensions of the follicles in the compared groups were roughly the same, i.e., no statistically significant differences were observed.

To examine atretic follicles, several criteria were used, and on their basis two phases of atresia could be conventionally distinguished in the ovaries: initial and final. Atretic follicles in the first phase showed fragmentation of nuclei, loss of the nuclear membrane, thickening of the zona pellucida, a disturbance of the arrangement of layers in the follicular epithelium, solitary mitoses, and loss of the clear outlines of the follicular cells. In atretic follicles in the second phase, the oöcyte was reduced in size, its nucleus severely deformed, while in the follicular epithelium the arrangement of the layers was completely disturbed, mitoses were absent, masses of chromatin were present in the nuclei, and, in addition, hypertrophy of the theca interna was observed. Comparison of the number and distribution of atretic follicles in ovaries of the experimental and control groups revealed no regular differences.

The following conclusion can be drawn from these observations. Right-sided ovariectomy in hamsters in the early postnatal period of development leads to hypertrophy of the residual left ovary and to considerable modification of its structure. Some workers [6] consider that at the age of 28 days, early spontaneous ovulations are observed in female hamsters, while others [3] consider that this phenomenon occurs on the 33rd-36th day. The appearance of corpora lutea, together with the increase in number of antral

follicles in the animals of the experimental group at the age of 28 days are undoubtedly facts indicating the more rapid maturation of the ovaries in the experimental animals. The question whether the recently formed corpora lutea in the ovaries of animals of the experimental group in some cases should be regarded as pseudoretention formations resulting from abortive ovulations requires further investigation.

The observed response of the ovary to unilateral ovariectomy in the early postnatal period must certainly be regarded as a phenomenon of compensatory hypertrophy. In the course of compensations of ovarian function, disturbed by the operation, definite correlations are found between the decrease in number of primordial follicles and the increase in number of ripening follicles.

The view is expressed in the literature that during compensatory hypertrophy of the ovaries in sexually mature female hamsters, there is a decrease in atresia of follicles of average size (330-340 μ). The present observations do not support these conclusions. In sexually immature animals the process of compensatory hypertrophy in the early postnatal period evidently takes place on account of a reserve of primordial follicles.

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