

FUNCTIONAL AND MORPHOLOGICAL STATE OF THE OVARIES AFTER HYSTERECTOMY

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In connection with improvements in surgery, anesthesia and antibiotics, recent years have seen an increasing application of surgical methods to the treatment of certain gynecological diseases. By comparison with the preceding decade, operative treatment of a common condition such as fibromyoma of the uterus has been used twice as often in the past ten years, and by comparison with the decade before that, three times as often as radiotherapy or x-ray therapy. Hysterectomy is the operation usually performed. The question arises, however, of the importance of the uterus to the function of the ovaries and of the body as a whole, and this has received little study. In the Soviet and non-Soviet literature experiments are described, the purpose of which was to show whether hysterectomy has any effect upon the function and morphology of the ovaries. For instance, according to the observations of A. P. Parfenov [5], after removal of the uterine cornua in rats, irregularity of the sex cycle appeared only after three months. After four months estrus developed every 8–10 days instead of every 4–5 days; after ten months and later the intervals between estrus were considerably prolonged and sometimes estrus was absent altogether. Roughly the same results were obtained by N. P. Verkhatskii [1]. According to M. D. Gutner and V. N. Aleksandrovskii [4], during the first few days after operation disturbances take place in the cycle; in the majority of animals it is restored to normal after 18–20 days. A prolongation of the period of estrus or of the resting stage is all that is observed. In some cases estrus disappeared until the tenth week and the intervals between estrus were irregular and prolonged. The observations of L. A. Shusser [6], continuing for a period of 8 months, showed that the intervals between estrus were prolonged on the average by 2–5 days, but apart from that, no abnormality was observed in the sex cycle.

The morphological condition of the ovaries was first studied experimentally in rabbits by I. N. Grammatikati [2]. On the basis of the detection of folliculin in different stages of development, he came to the conclusion that hysterectomy does not affect the ovarian activity. A. P. Parfenov, M. D. Gutner and V. N. Aleksandrovskii [4], N. P. Verkhatskii [1] and others discovered death of the follicles and other changes in the ovaries several months after operation. Intensive development of the corpora lutea was found. Some authors have attempted to explain the development of degenerative processes in the ovaries by disturbance of the anatomical connection between the uterus and ovaries. This point of view is supported by the work of N. P. Verkhatskii [1], M. D. Gutner [3], L. A. Shusser [6] and others.

In view of the discrepancies in the findings so far obtained, we decided to study the functional state and morphology of the ovaries after hysterectomy in our own experimental material.

METHOD

The investigation was conducted on 57 sexually mature female white rats weighing 150–200 g, of which 18 were controls. The functional state of the ovaries was studied by daily examination of vaginal smears. These

were obtained by washing with a sterile pipet, and then treated and stained with hematoxylin-eosin by the usual method. After several weeks of observation, when the regular sequence of the sexual cycles had been established for each rat, operations were performed on the animals. In all 39 rats underwent operation (6 series with 4-8 rats in each) at the same time of year — in the winter of 1956-57. Under ether anesthesia laparotomy was performed. A ligature was applied to the mesentery of the uterine cornua and both cornua completely excised. The stump of the uterus and the vessels were ligated with one or two fine catgut or silk ligatures and the abdomen was closed in layers. Control animals, from which vaginal smears were also taken daily, were kept under identical conditions with those undergoing operation. No smears were taken from the operated animals of each series (nor from the control animals of this series) for one week after operation. The taking of smears was then resumed until the time when the animals were sacrificed. In the course of a year about 10,000 vaginal smears were taken, treated and studied.

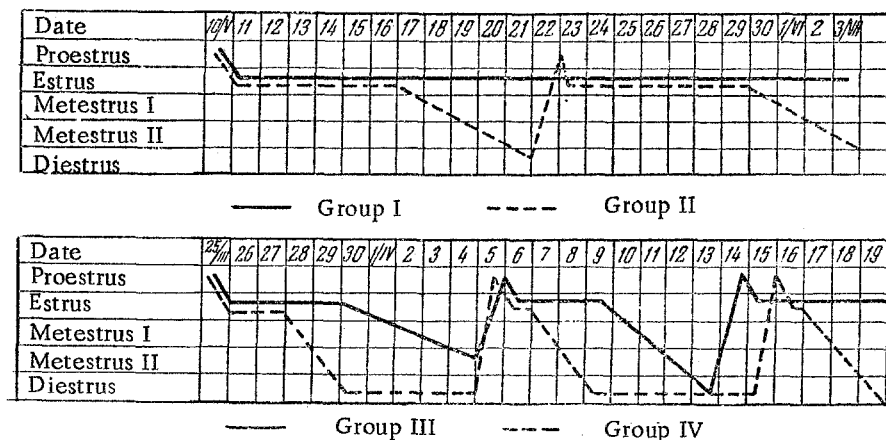
RESULTS

The results of our observations of the sexual cycles are essentially as follows. The sexual cycle in the control animals, and also in the experimental animals showed the following features. The sequence of the sexual cycles at first remained regular. The animals evidently withstood the operative trauma well. Four or five weeks after operation, however, the regular sequence of the sexual cycles was disturbed. The character of the disturbances varied; the experimental animals could be divided in this respect into several groups. The first group (15 rats) showed considerable prolongation of estrus (up to one month); only occasionally could the other stages of the cycle be observed. The second group (11 rats) showed prolongation of estrus to 7-8 days and slight prolongation of the metestrus stage. The third group (7 rats) showed a more or less regular sequence of a cycle which was prolonged to ten days. In this cycle the number of days of estrus varied between three and seven. Subsequently the cycle was shortened to 5-6 days, but at the same time the number of days of metestrus or rest was increased. The fourth group (6 rats) showed a prolongation of the resting stage to 3-6 days.

Typical examples of these cycles are shown graphically in the figure.

It must be pointed out that in certain rats disturbances of the usual pattern of the vaginal smears of different stages of the cycle took place even during early periods after operation. In the literature we were unable to find any description of an atypical pattern of the vaginal smears. We frequently observed round, atypical squamous cells, showing basophilic staining properties, confluent round cells, small dark basophilic cells, small cells with round, dark blue nuclei, elongated cells with dark nuclei and mucus and leukocytes, sometimes in large quantities. The variations were not observed in the control animals, so that they could not be attributed to fortuitous causes.

We studied the ovaries of control and operated rats sacrificed 4, 8, and 12 months after operation. Both ovaries appeared identical macroscopically. In the rats sacrificed one year after hysterectomy, the ovaries were considerably reduced in size and had undergone cystic changes. In the ovaries of the rats sacrificed 4 months after operation, corpora lutea were much more in evidence than other structures. The number of corpora lutea at



Changes in the sexual cycle of rats after hysterectomy.

different stages of development reached 15-16 in one section. Few follicles were observed at the different stages of development, and the Graafian follicle stage was rarely seen. Many follicles were in a state of atresia. From 8 to 12 months after operation atrophy of the ovaries was observed, and this was particularly marked in cases of cystic change, when the bulk of the ovary was composed of huge cavities, filled with brown contents and bounded by thin walls lined with a flattened epithelium. The atrophic ovaries contained numerous corpora lutea but no primordial follicles, all the follicles present being in a stage of atresia; the Graafian follicle stage was never observed.

Our findings support the view that hysterectomy is soon (after 1-2 months) reflected in the function of the ovaries and disturbs their activity, and a few months after operation morphological changes in the ovaries become evident.

As pointed out above, the disturbance of the activity of the ovaries is primarily expressed by the persistence of estrus. This fact has been observed by many workers, but they have not given any explanation of it. We believe that the cause of the persistence of estrus is the persistence of the corpora lutea and the resulting excess of lutein. Our investigations demonstrated the considerable persistence of the corpora lutea. Meanwhile the Graafian follicle stage is hardly ever seen and atresia of the follicles is found. Loeb [7] has also pointed out that the prolonged existence of the corpora lutea prevents the development of follicles and ovulation. K. P. Ulezko-Stroganova [5] observed that excessive luterinization is accompanied by death of the follicles. The cause of the proliferation of the corpora lutea is not yet clear. Lack of estrogenic hormone, combined with a temporary excess of lutein, is probably characteristic of the disturbed activity of the ovaries. After hysterectomy the ovaries are evidently deprived of its regulating influence. Hormone secretion continues, but the regular pattern of their production is disturbed.

SUMMARY

Hysterectomy provokes considerable changes of ovarian function in rats. This is primarily manifested in disturbance of the regularity of the sexual cycles. Persistence of rut is especially characteristic; it is evidently explained by a temporary excess of lutein, associated with a gradually increasing deficiency of the estrogenic hormone. Changes in the other stages of the sexual cycle are observed later with prolongation of the intervals between the rut periods. The ovaries continue to function.

Hysterectomy leads to pronounced degenerative changes in the ovaries as well (atrophy, prevalence of atretic follicles, disappearance of primordial follicles).

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