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Types of mammalian ovary.

By LEO LOEB (by invitation).

[*From the Department of Comparative Pathology, Washington University, St. Louis, Mo.*]

We can distinguish among mammals at least three types of ovaries. They are represented among the rodents by the ovaries of the guinea pig, rat and rabbit.

(1). In the first type, that of the guinea pig, in the œstrus period, preceding ovulation by a number of hours, the large majority of all follicles—all but the very small ones—begin to degenerate. In the larger follicles the granulosa becomes karyorrhectic en masse and connective tissue begins to grow into the follicular cavity after the destruction of the granulosa epithelium has progressed still further. In smaller follicles the process of destruction of the granulosa is less obvious and the granulosa cells disappear and here also connective tissue soon begins to invade the cavity. In the week following ovulation the very small follicles develop again and pass through their cycle; about eight days after ovulation the follicles have again reached full size and maturation on the one hand and atresia on the other hand can set in; this atresia usually affects only the large follicles.

(2). In the second type, that of the rat, ovulation is not preceded by a general atresia of follicles, but the large follicles mature, rupture and become converted into corpora lutea. There takes place throughout the cycle a limited atresia of follicles. In the rat the ingrowth of connective tissue into the atretic follicles is less active than in the guinea pig, in consequence of which the cavity of the degenerating follicle remains preserved during a longer period of time in the former species. In both guinea pig and rat ovulation is spontaneous. It occurs as soon as follicles have had a chance to mature and the inhibiting influence of the corpus luteum has ceased to exert itself. In the guinea pig a considerably longer period is necessary for the maturation of the follicles than in the rat, because in the former additional time is needed to allow follicles to develop from very small to large size, while in the rat only the very large follicles are destroyed at the time of ovulation and therefore maturation

of a new set of follicles can take place in a very short time. Inasmuch as also the functioning period of the corpus luteum is shorter in the rat than in the guinea pig and degeneration sets in much more rapidly in the former, the sexual cycle is much shorter in the rat than in the guinea pig.

(3). In the third type, that of the rabbit, not only does an atresia of follicles en masse not occur before ovulation, and thus less time is required for the production of new mature follicles after an ovulation has occurred, but in addition spontaneous ovulation does not occur in the rabbit; a copulation is usually required to call forth an ovulation. Thus in the female rabbit separated from the male instead of a rupture of the mature follicles an atresia of the large follicles occurs; in addition small follicles may also become occasionally atretic. In consequence of the absence of a spontaneous ovulation in the rabbit the second phase of the sexual cycle, that dominated by the corpus luteum, is absent in the female rabbit kept separated from males; but it is present after sterile copulation. It is normally present in the isolated female guinea pig and is absent in the rat on account of the shortness of the sexual cycle. In the mouse, according to E. Allen, spontaneous as well as non-spontaneous ovulation occurs.

Associated with these differences in the ovarian structure and function are differences which concern especially the development of the interstitial tissue. In the rabbit the thecæ internæ of atretic follicles show a considerable enlargement; at the same time they almost assume the character of a gland like structure; or of connective tissue under special conditions, namely when it organizes material which the connective tissue cells can phagocytize: thus a tissue originates consisting of large cuboidal cells, closely joined together. In the guinea pig the theca interna cells of atretic follicles remain on the whole small and do not in the least become similar to gland like structures. In the ovary of the rat the development of the theca interna has a character intermediate between that of the rabbit and and the guinea pig.

It can be understood that in view of the en masse occurrence of follicular atresia in the guinea pig and the subsequent development of later stages of atresia simultaneously in many follicles, sufficient space for the gland like development of interstitial tissue may not be available in the guinea pig. In the rabbit and rat where only isolated follicles degenerate the thecæ internæ

should have a better chance to expand and accordingly we find a greater development of the so-called interstitial gland in these species; it is most pronounced in the rabbit, where a periodic spontaneous formation of cyclic corpora lutea is lacking, and where thus the greatest amount of space is available for the development of an interstitial gland. It is therefore possible that the character of the interstitial tissue in the mammalian ovary is at least partly determined by mechanical factors more or less favorable to the expansion of the theca interna cells of atretic follicles.

It is also of interest to note that in the guinea pig the number of follicles rupturing at the time of ovulation is usually much smaller than in the rat and in the rabbit.

These differences between these species may perhaps depend upon a different degree of sensitiveness of the granulosa of the follicles. It is apparently greatest in the guinea pig, while the follicles are more resistant in the rabbit and rat. In all these species the sensitiveness of the follicles increases with increasing size, until maturing has been reached, when with the cessation of cell proliferation and an increase in cytoplasm a great increase in resistance seems to occur, which makes it possible for the mature follicle to withstand those influences which in other follicles cause atresia. This increase in resistance in the mature follicles makes ovulation possible. On the other hand the ova, which in all probability determine the development of the follicles (Loeb, Walsh), are at least as resistant in the guinea pig as in the rabbit and in the rat, and in the first species they tend apparently more strongly to progressive parthenogenetic changes within the ovary than in the rabbit and rat.

It would be of interest to study the ovaries of other mammalian species from this point of view, in order to determine which of these relationship are constant and which are variable among the various factors which we considered.