

HISTOPATHOLOGICAL CHANGES IN THE GENITAL TRACT OF MAMMALIAN FEMALES IN THE PERIOD OF FLOW

COMMUNICATION II. MORPHOPHYSIOLOGICAL CHANGES IN THE SPERM WHEN IN THE FEMALE GENITAL TRACT

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As we have shown in our previous communication* the spermatozoa of mice, entering the uterus during natural insemination, go through a period of activation, determined by the secretory activity of this organ. This activation, however, does not exhaust the processes going on in the contents of the genital tract after insemination. I. L. Ivanov [3], Königstein [6], and others have described the entrance of leucocytes into the lumen of the uterus, active phagocytosis of the sperm, and intensive disintegration of the male sex cells. Popa and Marza [7 and 8], White [12], and others have proved that sperm survives in utero for a shorter time than in vitro or in other media (experiments of White with brain tissues). On the basis of these facts, they concluded that the uterus has a harmful effect on living sperm. This view needs clarification in the light of its biological significance.

EXPERIMENTAL METHODS

We made detailed studies of the morphology and the changes undergone by the contents of the genital tract as well as the tissues of the various divisions of the genital tract and the ovaries of a female at various time intervals after natural insemination (0 to 72 hours). For these experiments we used white mice. The females were sacrificed at different time intervals after the natural inseminations. The sex organs were fixed in Bouin's liquid or Zenker-formalin and paraffined. Then transverse and longitudinal sections were made of the uterine horns and serial sections of the oviducts and the ovaries, with staining by hematoxylin-eosin and azure-eosin. In this fashion were treated the genital organs of females having had intercourse not in the period of flow (28 animals), several days after ovariectomy (14 females), and also several normal, virgin females in various stages of their sexual cycle (20 animals). In many cases the motility of the sperm within the uterus was studied and smears of uterine contents were made.

EXPERIMENTAL RESULTS

In the course of these experiments the following changes in the ejaculate were observed within the female organism. Immediately after intercourse, the uterine horns become distended by their contents, forming a rather viscous substrate, having no other elements besides the mass of spermatozoa (Fig. 1). As time passes after the

* Byull. Eksptl. Biol. i Med. 1955, No. 5, pp. 62-64.



Fig. 1. Smear of uterine contents of a normal female immediately after insemination. The formed elements are composed only of spermatozoa, packed rather densely.

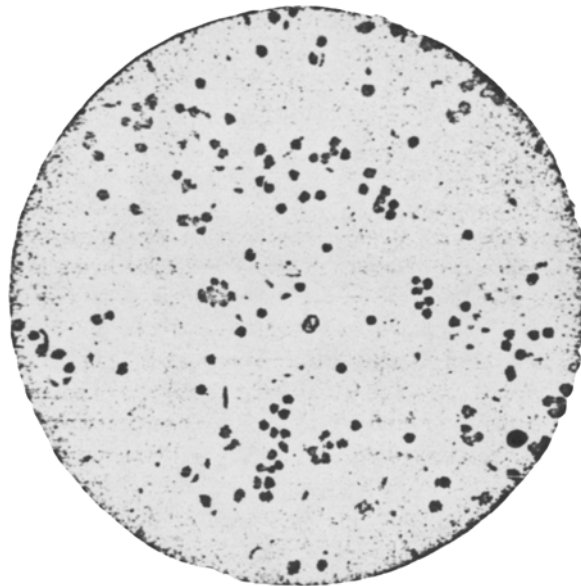


Fig. 2. The same after 9 hours. In the field of view -- infrequent, mostly broken down sperm cells, leucocytes, scattered degenerated epithelial cells.

sexual exposure, the stickiness and tight packing of the sex cells which exists makes movement difficult even as motility appears. Here and there are seen coagulated balls of sperm. The main mass of the coagulate forms a vaginal plug, preventing exit from the genital tract. As time accumulates from the moment of intercourse, the mass of sperm becomes less dense and their movements become intensified. In 4-5 hours leucocytes enter the mass, their number growing rapidly, and degenerated cells of the vaginal epithelium are seen as well as cells from the uterine lining. There commences an active spermatophagocytosis as well as disintegration of the spermatocytes (Figs. 2 and 3).

This infiltrative-destructive process in the uterine contents progresses until the vaginal plug falls out, thus emptying the genital tract, this event occurring 15-20 hours after intercourse. As to the speed and rapidity of the disintegration of the sperm, there is the testimony of this fact. If the contents of the genital tract are artificially retained by ligating the uterine horns and the vagina, then within 36 hours there is no trace left of the spermatozoa.

It follows, then, that in the genital tract processes develop which lead to the rapid destruction of live sperm. Furthermore, these processes are an active function of the normal female. Our observations have shown that sperm in vitro or in castrated females, whose sex function is thus disturbed, are disintegrated to only a very slight degree.



Fig. 3. Active spermatophagocytosis several hours after insemination (high magnification).

Are these observed processes a hindrance to fertility? To this it is necessary to respond in the negative. We have shown that sperm destruction occurs, as a rule, only after ovulation and a meeting of the gametes. Our observations have further demonstrated that the infiltrative and destructive events occurring to the contents of the uterus are directly connected with the special events taking place at the same time in the walls of the genital tract. These are also occurrences taking place after ovulation in unfertilized females, even if in these the intrauterine leucocytosis is much less marked. It follows from this that the infiltrative-destructive processes occurring in the lumina and walls of the fertilized females comprise an integral part of a single biologic process which must be viewed as not only a function of the insemination but also as a functional step in the activities of the female genital tract. The constructive significance of this process, in our opinion, lies in making certain of a change in the contents of the genital tract (partially by way of the removal of the vaginal plug), and also in the reconstruction of the mucous membrane lining the uterus, thus preparing it for implantation of the embryo.

In our opinion, the entire time of the presence of sperm in the female genital tract can be divided into two periods. The first period (period of activation) lasts from the act of insemination to the time of ovulation, this being a climate favorable for sperm staying alive. In this period of time, also, the spermatozoa are enabled

to penetrate the upper reaches of the genital tract. The second period we call the destructive-infiltrative, beginning from the moment of ovulation and actual fertilization and terminating with the removal of the sex products of the male from the genital tract of the female. It is after this second period that the fertilized egg cells enter the uterus and are there implanted. Both the first and the second periods are only normal stages of the process of insemination as a whole.

At this point it is essential to discuss the question as to whether, in mammals, sperm are able to penetrate into the lining of the genital tract, this having drawn the attention of numerous investigators. This phenomenon was first described by Kohlbrugge [4, 5] in 1910, 1911, and 1912 as occurring in tropical bats, rabbits, and white mice, as well as chickens and elasmobranchs. The ideas of Kohlbrugge are contradictory to those of earlier workers (Königstein [6], Waldstein [11], and were subjected to strong criticism by Sobotta [9, 10]. Lately, new data has been obtained on the question of sperm penetration in uteri of mice [1, 2]. It must be said that we did not observe this process of sperm penetration in mice uteri, although we used the same method as did Genin. We considered to be the elements observed by this author and which he considered to be sperm penetrating the uterine walls, are in reality lymphocytic nuclei, polymorph leucocytes, products of degeneration of epithelial cells, etc.

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* In Russian.