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Answer

Cyclic Changes In the Vagina

A cyclical process is one in which a series of events happens again and again in the same order. Much of ordinary social life is organized in **cyclic changes**: those of the day, the week, and the year. These short-term **cyclic changes** may be regarded as conditions necessary for structural stability. Vaginal cytology was evaluated weekly over 12 months in 20 adult female Cynomolgus monkeys (Macaca fascicularis). After sacrifice of the animals the histology of the ovaries, uterus and vagina were studied in different phases of the menstrual cycle. The cytological examination of the vaginal smears showed that the superficial cells increased in number towards the middle of the cycle and the number of intermediate cells declined gradually. Parabasal cells were observed mainly at the beginning of the cycle; they disappeared towards the middle of the menstrual cycle. During the early follicular phase, the cells were moderately separated from each other, and during the second half of the proliferative or follicular phase, the superficial cells appeared clumped together. Leucocytes were usually absent except for at the beginning of the cycle and in the last few days of the late secretory or luteal phase. The maturation index of the vaginal smears can be considered as a tool for distinguishing the different phases of the menstrual cycle. The microscopic examination of the genital organs showed that during the proliferative or follicular phase of the cycle, which corresponds to the development of the ovarian follicles, the uterus showed growth of endometrial glands, stroma and endothelial cell proliferation with capillary sprouts. Shortly after ovulation and parallel to the formation of the corpora lutea, the endometrium enters the secretory or luteal phase, which is characterized by coiling of endometrial glands, glandular secretion and the differentiation of the spiral artery. The most striking changes in the vagina, is the marked basal cell proliferation and thickening of the stratum granulosum during the follicular phase of the menstrual cycle. The histological changes observed in the vagina demonstrated a good correlation with the observation on cytological examination of the smears. The present study demonstrated that the process of angiogenesis in the uterus during the different phases of the menstrual cycle is a multiple phenomenon involving proliferation, maturation and differentiation.

The Cyclic Changes In The Breasts

A cyclical process is one in which a series of events happens again and again in the same order. Much of ordinary social life is organized in cyclic changes: those of the day, the week, and the year. These short-term cyclic changes may be regarded as conditions necessary for structural stability. The volumes and spin-lattice (T1) relaxation times of breast tissues and parenchymal water content were measured non-invasively by magnetic resonance imaging (MRI) in eight healthy women during four to eight consecutive menstrual cycles. Total breast volume, and parenchymal volume, T1 relaxation time and water content were lowest between days 6 and 15. Between days 16 and 28, parenchymal volume, T1 relaxation time and water content rose sharply by 38.9%, 15.1% and 24.5%, respectively, and peaked after day 25. Within 5 days of the onset of menses, parenchymal volume fell sharply by 30.3%, while water content declined by 17.5%. Rising parenchymal volume in the second half of the menstrual cycle is not solely due to increased tissue water content and provides in vivo evidence for both growth and increased tissue fluid at this time.

Estrogen and progesterone are the only natural hormones we know of that increase breast size. These hormones are believed to be responsible for the cyclical changes that many women feel in their breasts just before menstruation. These include swelling, pain, and soreness. During menstruation, many women also have changes in breast texture. Their breasts may feel very lumpy.

Menstrual Cycle

Introduction: A female's menstrual cycle occurs to allow for oocyte release and prepare the uterus for possible pregnancy. It begins at puberty, ranging from the ages of 10 to 16, and ends at menopause at an average age of 51. It may last anywhere from 21 days to 35 days with an average duration of 28 days.

Function: Hormones are secreted in a negative and positive feedback manner to control the menstrual cycle. Hormone secretion begins in the hypothalamus where gonadotropin-releasing hormone (GnRH) is secreted in an increased, pulsatile fashion once puberty starts. GnRH is then transported to the anterior pituitary where it activates its 7-transmembrane G-protein receptor. This provides a signal to the anterior pituitary to secrete stimulating follicle hormone (FSH) and luteinizing hormone (LH). FSH and LH provide input to the ovaries. Within the ovarian follicle, there are 2 cell types responsible for hormone production, theca cells, and granulosa cells. LH stimulates theca cells to produce progesterone and androstenedione by activating the enzyme, cholesterol desmolase. Once androstenedione is secreted, the hormone diffuses to the nearby granulosa cells. Here, FSH stimulates the granulosa cells to convert androstenedione to testosterone then 17-beta-estradiol by activating the enzyme, aromatase. As levels of 17-beta-estradiol or progesterone increase based on the phases of the menstrual cycle, there is negative feedback back to the anterior pituitary to lower the levels of FSH and LH being produced and subsequently, the levels of 17-beta-estradiol and progesterone produced. An exception to this is during ovulation, in this case, once a critical amount of 17-beta-estradiol is produced it provides positive feedback to the anterior pituitary to produce increased amounts of FSH and LH. This feedback system is represented in figure 1. Additionally, within the feedback system, the granulosa cells produce inhibin and activin, which inhibit and stimulate FSH release from the anterior pituitary, respectively. This feedback mechanism is controlled by up regulating, to increase hormone production, or down regulating to decrease hormone production, the GnRH receptors on the anterior pituitary.

Mechanism:

Phase 1: The Follicular, or Proliferative Phase

The first phase of the menstrual cycle is the follicular or proliferative phase. It occurs from day zero to day 14 of the menstrual cycle, based on the average duration of 28 days. The variability in length of the menstrual cycle occurs due to variations in the length of the follicular phase. The main hormone during this phase is estrogen, specifically 17-beta-estradiol. The increase in this hormone occurs by upregulation of the FSH receptors within the follicle at the beginning of the cycle. However, as the follicular phase progresses to the end, the increased amounts of 17-beta-estradiol will provide negative feedback to the anterior pituitary. The purpose of this phase is to grow the endometrial layer of the uterus. 17-beta-estradiol achieves this by increasing growth of the endometrial layer of the uterus, stimulating increased amounts of stroma and glands, and increasing the depth of the arteries that supply the endometrium, the spiral arteries. Additionally, this phase is also important to create an environment that is friendly and helpful to possible incoming sperm. 17-beta-estradiol achieves this by creating channels within the cervix allowing for sperm entry. The channels are made within the abundant, watery and elasticity changes of the cervical mucous. During this phase, a primordial follicle begins to mature to a Graafian follicle. The surrounding follicles begin to degenerate which is when the Graafian follicle becomes the mature follicle. This sets up the follicle for ovulation, the next step.

Ovulation

Ovulation always occurs 14 days before menses; therefore, with an average 28-day cycle, ovulation occurs on day 14. At the end of the proliferative phase, 17-beta-estradiol levels are at a high due to the follicle maturation and increased production of the hormone. During this time only, 17-beta-estradiol provides positive feedback for FSH and LH production. This occurs when a critical level of 17-beta-estradiol is reached, at least 200 picograms per milliliter of plasma. The high levels of FSH and LH present during this time is called the LH surge. As a result, the mature follicle breaks, and an oocyte is released. The changes to the cervix as initiated during the follicular phase further increases allowing for increased, waterier cervical mucous to better accommodate the possible sperm. The levels of 17-beta-estradiol fall at the end of ovulation.

Phase 2: The Luteal or Secretory Phase

The next phase of the menstrual cycle is the luteal or secretory phase. This phase always occurs from day 14 to day 28 of the cycle. Progesterone stimulated by LH is the dominant hormone during this phase to prepare the corpus luteum and the endometrium for possible fertilized ovum implantation. As the luteal phase ends, progesterone will provide negative feedback to the anterior pituitary to decrease FSH and LH levels and subsequently, the 17-beta-estradiol and progesterone levels. The corpus luteum is a structure formed in the ovary at the site of the mature follicle rupture to produce 17-beta-estradiol and progesterone, which is predominate at the end of the phase due to the negative feedback system. The endometrium prepares by increasing its vascular supply and stimulating more mucous secretions. This is achieved by the progesterone stimulating the endometrium to slow down endometrial proliferation, decrease lining thickness, develop more complex glands, accumulate energy sources in the form of glycogen, and provide more surface area within the spiral arteries. Contrary to the cervical mucous changes seen during the proliferative phase and ovulation, progesterone decreases and thickens the cervical mucous making it non-elastic, since the fertilization time period passed, and sperm entry is no longer a priority. Additionally, progesterone increases the hypothalamic temperature, so body temperature increases during the luteal phase. Near the end of the secretory phase, plasma levels of 17-beta-estradiol and progesterone are produced by the corpus luteum. If pregnancy occurs, a fertilized ovum is implanted within the endometrium, and the corpus luteum will persist and maintain the hormone levels. However, if no fertilized ovum is implanted, then the corpus luteum regresses, and the serum levels of 17-beta-estradiol and progesterone decrease rapidly.

Menses

When the hormone levels decrease, the endometrium layer as it has been changed throughout the menstrual cycle is not able to be maintained. This is called menses, considered day 0 to day 5 of the next menstrual cycle. The duration of menses is variable. Menses or menstrual bleeding is when there is sloughing of the endometrial lining and its blood. To continue the process of the menstrual cycle, primordial follicles begin to develop and start the follicular phase again in hopes of a pregnancy.

Clinical Significance: A female has an average of 450 menses throughout her lifetime; therefore, it is important to understand the menstrual cycle and its physiology because of the various complications, consequences, and distress that it may have for a female patient. A female presenting with primary or secondary amenorrhea will need to undergo clinical testing to diagnose the reason, but reasonable testing from the level of the ovaries to the hypothalamus cannot be performed unless a clinician thoroughly understands the hormone feedback system. Additionally, there may be problems with her menses itself such as premenstrual syndrome, dysmenorrhea, or menorrhagia. Without an understanding of the female anatomy and menstrual cycle physiology, a clinician would be unable to obtain a complete history and physical to allow understanding of the underlying cause. Infertility is a

prominent issue in our society, and the menstrual cycle is the basis for how a woman's body prepares for pregnancy, so each patient's menstrual cycle must be evaluated as a possible area of concern for her infertility. As clinicians, we must understand the menstrual cycle in its entirety to provide relevant clinical care to our female patients.