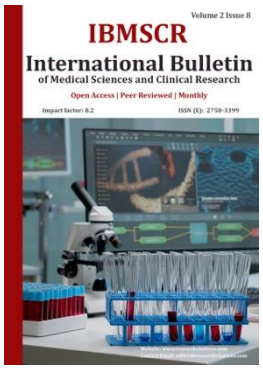

MORPHOLOGY AND PHYSIOLOGY OF FEMALE REPRODUCTION

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Introduction

The female reproductive system functions to produce eggs (ova), sex hormones, and support the development of fertilized eggs into mature fetuses ready for birth. It operates between menarche (the onset of menstruation) and menopause (the cessation of menstruation for 12 consecutive months). Throughout this timeframe, there's a cyclical release of eggs from the ovary, which have the potential to be fertilized by male sperm. This cyclical release of eggs is a natural aspect of the menstrual cycle.

Keywords: oogonia, ovaries, clitoris, vulvar vestibule, the uterus, Bartholin's glands, luteinizing hormone.

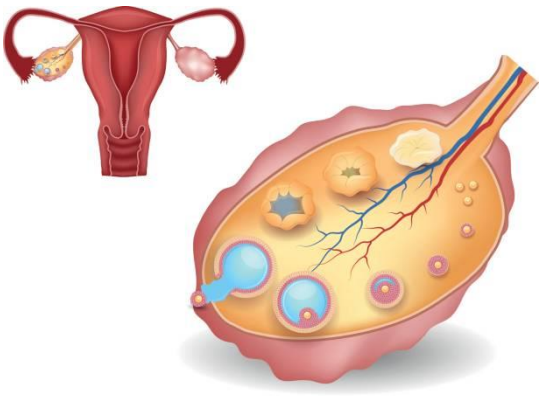
Development

Female gametes originate from germ cells. During fetal development, oogonia undergo rapid division, resulting in approximately 7 million germ cells by the 7th month of gestation. Subsequently, the number of germ cells undergoes a rapid decline, with most oogonia perishing while the remaining cells, known as primary oocytes, initiate the initial meiotic division. These cells arrest in prophase I and remain in a dormant state until menarche. Each primary oocyte is enveloped by a primordial follicle composed of granulosa and theca cells. As primordial follicles mature, the granulosa cells multiply, forming concentric layers around the oocyte, which undergoes significant volumetric expansion. Upon reaching menarche, specific groups of oocytes periodically resume meiosis and continue their development. At the point of fertilization, oocytes are arrested in metaphase II. Upon expulsion of its second polar body, the oocyte transforms into an ovum. Subsequent meiosis reinitiates upon activation by a sperm cell during fertilization.

Organ Systems Involved

Ovaries

The ovaries serve as the female gonads, responsible for gametogenesis and the production of sex hormones. Within each ovary, the outer cortex facilitates follicular development, while the inner medulla houses blood vessels and connective tissue.



Fallopian Tubes

- The vulva encompasses the external female genitalia, including the labia majora, labia minora, clitoris, vulvar vestibule, urethral meatus, and vaginal orifice. The labia majora lie laterally to the labia minora, merging anteriorly to form the mons pubis, which overlays the pubic symphysis. Positioned medial to the labia minora, the vulvar vestibule houses the openings of the urethra and vagina. Bartholin's glands are situated lateral to the vaginal opening.
- The vagina is a flexible, fibromuscular tubular structure extending from the vulvar vestibule to the uterine cervix, with its distal end known as the introitus. Its anterior part lies adjacent to the posterior wall of the bladder, while its posterior part is contiguous with the anterior wall of the rectum.
- The uterus comprises the corpus (body) and cervix. The fundus forms the superior aspect of the uterine corpus, while the isthmus or lower uterine segment adjoins the cervix. Three distinct layers compose the uterine walls: the endometrium, myometrium, and serosa. The endometrium lines the uterine cavity and undergoes changes in thickness and structure in response to hormonal fluctuations. The myometrium, consisting of smooth muscle fibers, represents the middle and thickest layer, while the serosa forms the outermost covering of the uterus.
- The uterine cervix serves as a tubular link connecting the uterine cavity with the vagina, facilitating passage between the two. The lower cervix meets the upper vagina at the cervical os. The portion of the cervix extending into the vagina is termed the ectocervix and is composed of stratified squamous epithelium. Conversely, the endocervix lines the inner cervical canal with columnar epithelium. The transformation zone marks the boundary where columnar epithelium transitions to squamous epithelium, and it is frequently the site of cervical dysplasia and malignant changes.
- Fallopian tubes serve as conduits for oocytes to travel from the ovaries to the uterine cavity. The fimbria, found near the ovary, are finger-like projections aiding in the movement of the released oocyte into the tube. These fimbria transition into the ampulla, the widest part of the tube. As the lumen narrows, the ampulla becomes the isthmus, which directs towards the uterus. Finally, the tube extends into the uterus, forming the interstitial portion, where the oocyte exits the tube to enter the uterine cavity.

Uterus

1. The uterus is comprised of two main parts: the corpus (body) and the cervix. The uppermost part of the uterine corpus is known as the fundus, while the lower segment adjacent to the cervix is referred to as the isthmus or lower uterine segment. Within the uterine walls, three distinct layers can be identified: the endometrium, myometrium, and serosa. The endometrium lines the uterine cavity, its thickness and composition varying in response to hormonal fluctuations. The myometrium, consisting of smooth muscle fibers, forms the middle and thickest layer of the uterine wall, providing the primary contractile force during labor. Finally, the serosa serves as the outermost layer of the uterus, providing protective coverage.
2. The uterine cervix acts as a tubular connection between the uterine cavity and the vagina, serving as a conduit for menstrual flow and facilitating childbirth. The lower cervix opens into the upper vagina at the cervical os. The ectocervix, which extends into the vagina, is lined with stratified squamous epithelium, while the endocervix, lining the cervical canal, is composed of columnar epithelium. The region where these two types of epithelium meet is known as the transformation zone, which is particularly susceptible to cervical dysplasia and malignant changes.

Vagina

The vagina is a pliable, fibromuscular tubular organ that stretches from the vulvar vestibule to the uterine cervix. At its outermost end lies the introitus, the opening into the vaginal canal. Positioned anteriorly, the vagina is adjacent to the posterior wall of the bladder, while posteriorly, it lies against the anterior wall of the rectum.

Vulva

The vulva encompasses the external female genitalia, including the labia majora, labia minora, clitoris, vulvar vestibule, urethral meatus, and vaginal orifice. The labia majora are positioned laterally to the labia minora and converge anteriorly to form the mons pubis, a layer covering the pubic symphysis. The vulvar vestibule, situated medially to the labia minora, houses the openings of the urethra and vagina. Bartholin's glands open laterally to the vaginal opening.

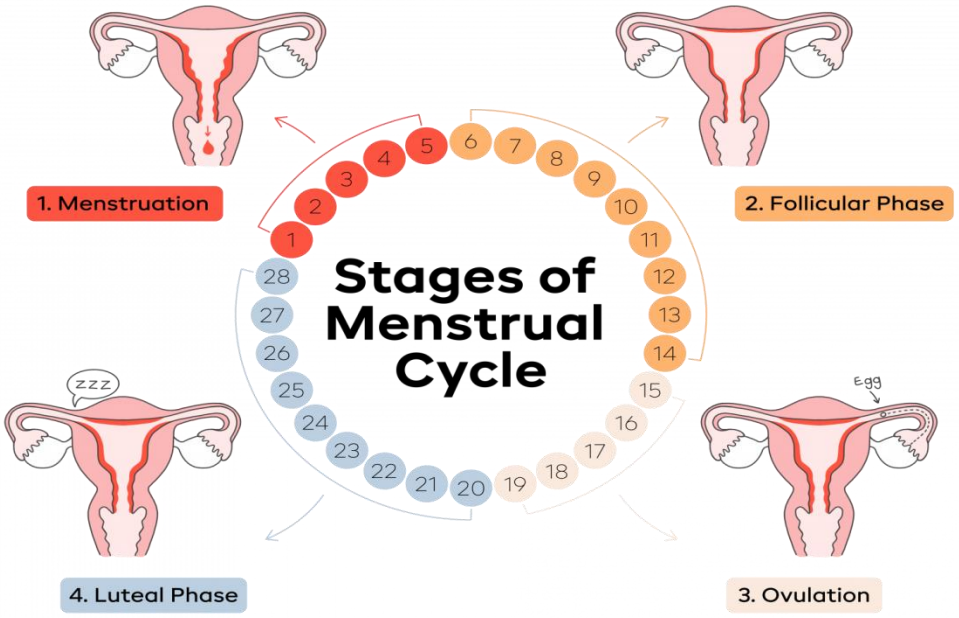
Function

The onset of menarche signifies a female's initial menstrual cycle, characterized by the commencement of menstrual bleeding. Menarche typically occurs during puberty, accompanied by breast development, growth of axillary and pubic hair, and a notable growth spurt. With the onset of each menstrual cycle, several primordial follicles within the female's ovaries undergo further maturation. Among them, one follicle emerges as dominant and continues to mature, while the remaining follicles undergo atresia, ceasing their development.

As the dominant follicle progresses, it transforms into a Graafian follicle, completing meiosis I and releasing the ovum from its prophase I arrest. During ovulation, the Graafian follicle expels the ovum, now termed the corpus luteum, from its surrounding tissue. In the absence of fertilization, declining levels of progesterone prompt the shedding of the secretory endometrial lining, resulting in menstrual bleeding. Conversely, if fertilization occurs, the fertilized egg implants into the endometrial wall, and the endometrial lining is sustained by progesterone secretion, initially facilitated by the corpus luteum until the placenta assumes this role.

Mechanism

The menstrual cycle typically consists of two main phases: the follicular phase and the luteal phase, with ovulation occurring between them. The follicular phase initiates with menstrual bleeding and concludes just before the surge in luteinizing hormone (LH). On the other hand, the luteal phase begins with the LH surge and ends with the onset of menstruation. An average cycle spans about 28 days, with the luteal phase lasting approximately 14 days, while the duration of the follicular phase can vary.



At the onset of the follicular phase, estradiol and progesterone levels are low. The absence of inhibitory feedback prompts an increase in pulsatile gonadotropin-releasing hormone (GnRH), leading to elevations in follicle-stimulating hormone (FSH) and LH levels. This surge in FSH stimulates the maturation of follicles, facilitating the growth of a select few. As these follicles grow, FSH and estradiol levels rise. By the end of the follicular phase, a dominant follicle emerges, reaching a size of approximately 20-25mm. Elevated estradiol levels prompt thickening of the endometrium in preparation for potential egg implantation.

Upon reaching a critical threshold, estradiol switches from inhibitory to stimulatory feedback on LH, causing a significant surge in LH concentration (with a smaller surge in FSH levels). Roughly 36 hours after the LH surge, the oocyte is released from the dominant follicle and travels through the fallopian tube to the uterus. Meanwhile, the remaining follicular tissue, known as the corpus luteum, begins to secrete progesterone. This hormone inhibits the release of LH and FSH while stimulating the formation of the secretory endometrium. In the

absence of fertilization, declining LH levels lead to decreased progesterone and estradiol levels. However, if fertilization occurs, the implanted egg releases chorionic gonadotropin, sustaining the corpus luteum and progesterone production.

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