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COURSE: PHS 212 (PHYSIOLOGY)

QUESTIONS

1. Briefly discuss the CYCLIC CHANGES in any two of the following
   a) CERVIX (b) VAGINA (c) BREASTS
2. Explicate any one of the following:
   - Menstrual cycle
   - Hormonal regulation of the menstrual cycle

ANSWERS

1) CERVIX

EFFECT OF ESTROGEN ON THE CERVIX

Estrogen produces the following changes in uterus:

i. Enlargement of uterus to about double of its childhood size due to the proliferation of endometrial cells

ii. Increase in the blood supply to endometrium

iii. Deposition of glycogen and fats in endometrium

iv. Proliferation and dilatation of blood vessels of endometrium

v. Proliferation and dilatation of the endometrial glands, which become more tortuous with increased blood flow

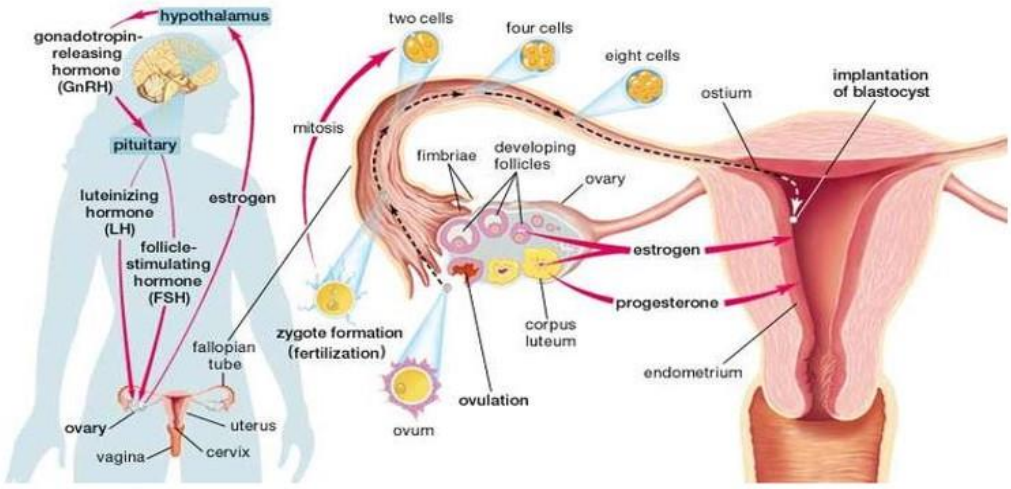
vi. Increase in the spontaneous activity of the uterine muscles and their sensitivity to oxytocin

vii. Increase in the contractility of the uterine muscles.

All these changes prepare uterus for pregnancy. In some species, the cervical canal widens under the influence of estrogen. During fertilization, under the influence of estrogen the cervix secretes highly hydrated mucus, often exceeding 96% water in women. The extent of hydration is correlated with penetrability to sperm.

EFFECT OF PROGESTERONE ON THE CERVIX

Progesterone converts the endometrium to its secretory stage to prepare the uterus for implantation. At the same time progesterone affects the vaginal epithelium and cervical mucus, making it thick and impenetrable to sperm. This effect is utilized in the contraceptive actions of minipills.



BREASTS

EFFECT OF ESTROGEN ON THE BREASTS

Effect of estrogen on the breast are:

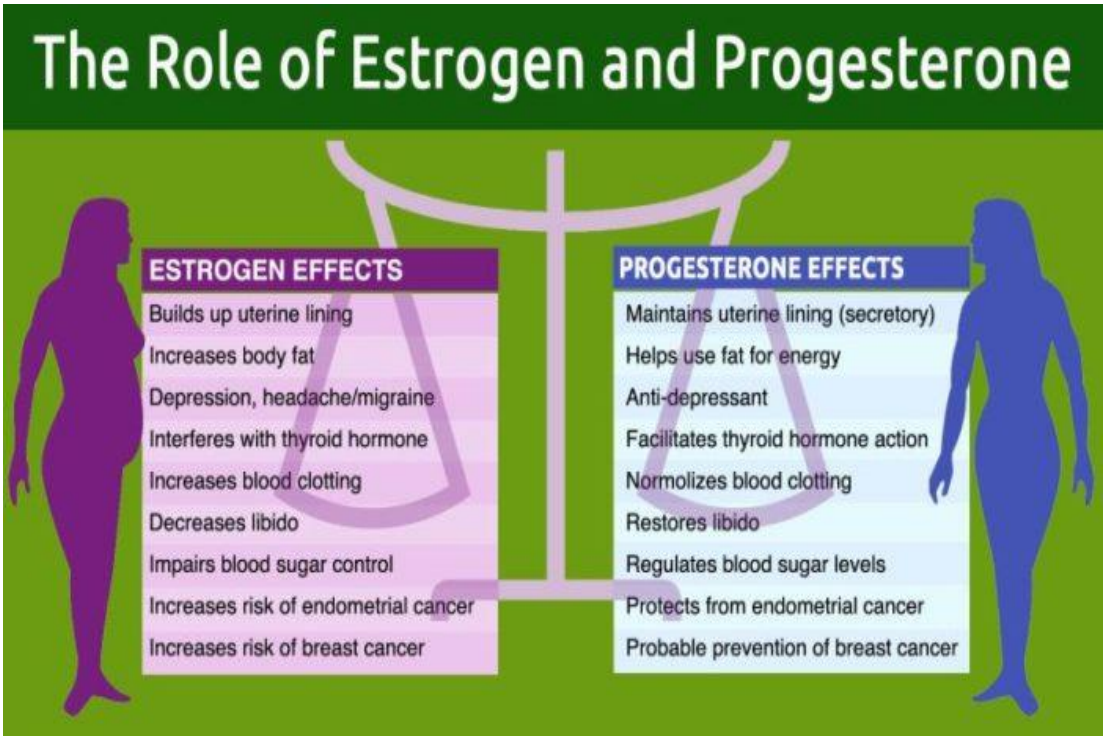
i. Development of stromal tissues of breasts
ii. Growth of an extensive ductile system
iii. Deposition of fat in the ductile system.

All these effects prepare the breasts for lactation. Estrogen causes development of lobules and alveoli of the breasts, to some extent. However, progesterone is necessary for the full growth of breast and prolactin is necessary for its function. Each month, women go through changes in the hormones that make up the normal menstrual cycle. The hormone estrogen is produced by the ovaries in the first half of the menstrual cycle. It stimulates the growth of milk ducts in the breasts. The increasing level of estrogen leads to ovulation halfway through the cycle. Next, the hormone progesterone takes over in the second half of the cycle. It stimulates the formation of the milk glands. 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. This is because the glands in the breast are enlarging to get ready for a possible pregnancy. If pregnancy does not happen, the breasts go back to normal size. Once menstruation starts, the cycle begins again.

EFFECT OF PROGESTERONE ON THE BREASTS

Progesterone promotes the development of lobules and alveoli of mammary glands by proliferating and enlarging the alveolar cells. It also makes the breasts secretory in nature. It makes the breasts to swell by increasing the secretory activity and fluid accumulation in the subcutaneous tissue. The major developmental role of progesterone in the normal breast has been postulated to be the formation of lobular-alveolar structures during pregnancy. It is involved in the maturation of breast cells and decreases the rate of multiplication. Progesterone also promotes normal cell death in the breast which is important in the prevention of cancer.



2) MENSTRUAL CYCLE

Menstrual cycle is defined as cyclic events that take place in a rhythmic fashion during the reproductive period of a woman's life. In late puberty, adolescent girls experience their first menstruation, an event known as menarche, and menstrual cycles commence, continuing until menopause (unless interrupted by pregnancy). These cycles last an average of 28 days and consist of three phases:

■ The follicular phase, characterized by proliferation of the endometrium of the uterus and development of ovarian follicles.

■ The ovulatory phase, during which one follicle that has fully matured ruptures and releases an ovum.

■ The luteal phase, characterized by transformation of follicular cells into a corpus luteum and further proliferation of the endometrium. Unless implantation of a fertilized ovum takes place, the corpus luteum regresses and menses follows, during which the proliferated endothelium is sloughed off and bleeding occurs for a period of 3 to 5 days.

Follicular Phase

During each cycle, after the onset of menses (by convention, "day 1" of the cycle), several primordial ovarian follicles begin to undergo further development under the influence of FSH, and hence, the term follicular phase is used to describe the first half of the cycle. Within the developing follicles, theca interna cells secrete androgens, which are converted to estradiol by the granulosa cells of the follicles. This conversion is stimulated by LH. Estradiol causes endometrial proliferation, as well as development of glands and growth of spiral arteries within the endometrium, in preparation for possible implantation of a fertilized egg. For this reason, the follicular phase is also called the proliferative phase. In addition, estradiol promotes secretion of watery cervical mucus, through which sperm can enter the uterus. Ultimately, one of the developing follicles predominates and becomes a mature follicle (Graafian follicle), and the others regress.

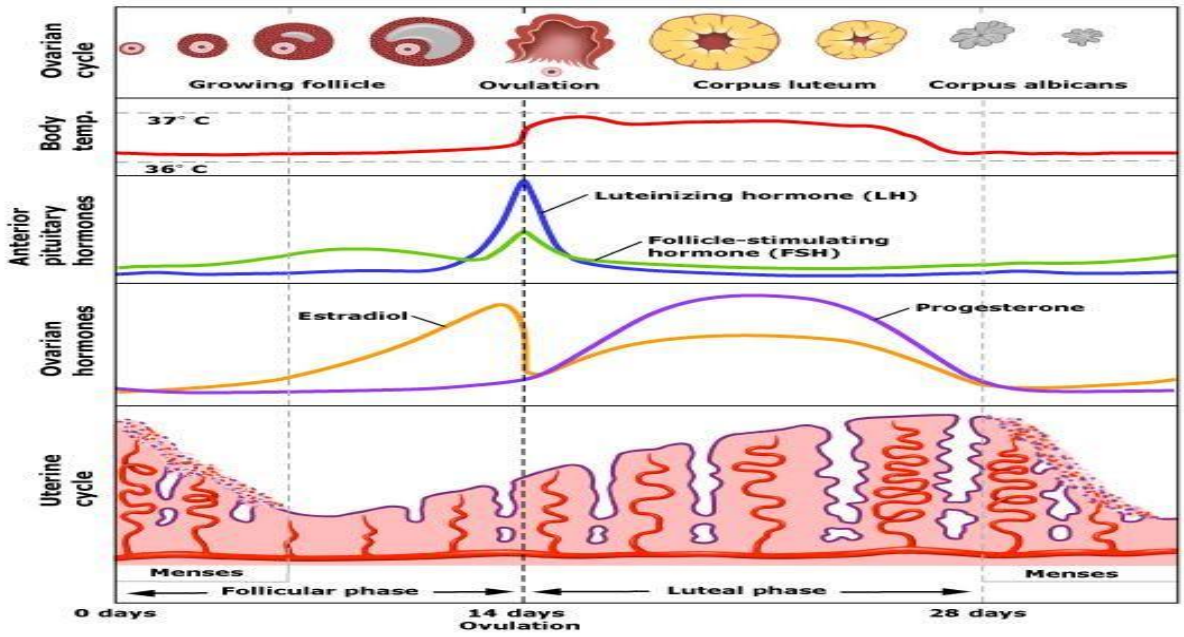
Ovulatory Phase

Estradiol exerts negative feedback on the hypothalamic secretion of GnRH and anterior pituitary secretion of FSH (LH is not suppressed during this period) through much of the follicular phase. Additionally, granulosa cells of developing follicles secrete a peptide hormone, inhibin, which has negative feedback effects specifically on FSH. Toward the end of the follicular phase, estradiol rises to a level at which positive feedback is triggered. A surge in LH, and to a lesser extent, FSH, takes place and produces ovulation at midcycle, releasing a mature ovum, which is carried by ciliary action into the fallopian tube. Interestingly, a mature ovum is produced in alternating ovaries from month to-month, but if a woman has only one functional ovary, that one ovary will normally produce a mature ovum monthly.

Luteal Phase

In the ensuing luteal phase of the cycle, the ruptured follicle undergoes involution, forming the corpus luteum. Progesterone and inhibin production by the corpus luteum rise, as does estradiol production to a lesser degree. Estrogens, progesterone, and inhibin now contribute to negative feedback on the hypothalamus and anterior pituitary. Further proliferative and secretory changes take place in the endometrium, stimulated by progesterone; the luteal phase is also called the secretory phase for this

reason. In the cervix, secretions become thicker, making passage of sperm into the uterus more difficult. Conception must take place within a day or two of ovulation, because the ovum is viable for only a short period after release from the Graafian follicle (normally, conception takes place while the egg is in transport within a fallopian tube). Toward the end of the luteal phase, unless pregnancy occurs, steroid and inhibin secretion fall, and menses results. The pubertal growth spurt typically begins earlier in girls than in boys. Previously, it was believed that androgens (testosterone and adrenal androgens) were responsible for the rapid increase in height. Recent studies, however, have demonstrated that although testosterone increases bone mass and density, estradiol is the hormone primarily responsible for the growth spurt in both sexes. Estradiol stimulates long bone growth but also promotes closure of the growth plates. Females, who enter puberty earlier, attain less adult height than males.



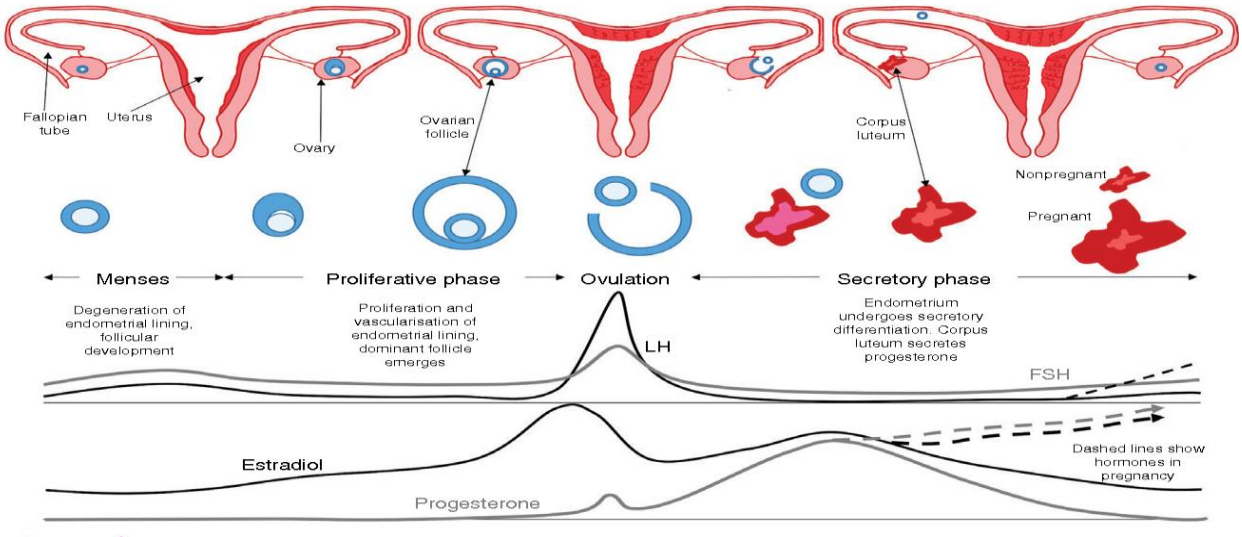


FIG 2.1 AND 2.2- Overview of the phases of the menstrual cycle

- APPLIED PHYSIOLOGY –

- MENSTRUAL SYMPTOMS

Menstrual symptoms are the unpleasant symptoms with discomfort, which appear in many women during menstruation. These symptoms are due to hormonal withdrawal, leading to cramps in uterine muscle before or during menstruation.

Common Menstrual Symptoms

1. Abdominal pain

2. Dysmenorrhea (menstrual pain)

3. Headache

4. Occasional nausea and vomiting

5. Irritability

6. Depression

7. Migraine (neurological disorder, characterized by intense headache causing disability).

- PREMENSTRUAL SYNDROME

Premenstrual syndrome (PMS) is the symptom of stress that appears before the onset of menstruation. It is also called premenstrual stress syndrome, premenstrual stress or premenstrual tension. It lasts for about 4 to 5 days prior to menstruation. Symptoms appear due to salt and water retention caused by estrogen.

Common Features

1. Mood swings

2. Anxiety

3. Irritability

4. Emotional instability

5. Headache

6. Depression

7. Constipation

8. Abdominal cramping

9. Bloating (abdominal swelling).

- ABNORMAL MENSTRUATION

1. Amenorrhea: Absence of menstruation

2. Hypomenorrhea: Decreased menstrual bleeding

3. Menorrhagia: Excess menstrual bleeding

4. Oligomenorrhea: Decreased frequency of menstrual bleeding

5. Polymenorrhea: Increased frequency of menstruation

6. Dysmenorrhea: Menstruation with pain

7. Metrorrhagia: Uterine bleeding in between menstruations.

- ANOVULATORY CYCLE

Anovulatory cycle is the menstrual cycle in which ovulation does not occur. The menstrual bleeding occurs but the release of ovum does not occur. It is common during puberty and few years before menopause. When it occurs before menopause, it is called perimenopause. If it occurs very often during childbearing years, it leads to infertility.

Common Causes

1. Hormonal imbalance

2. Prolonged strenuous exercise program

3. Eating disorders

4. Hypothalamic dysfunctions

5. Tumors in pituitary gland, ovary or adrenal gland

6. Long-term use of drugs like steroidal oral contraceptives.