The reproductive system

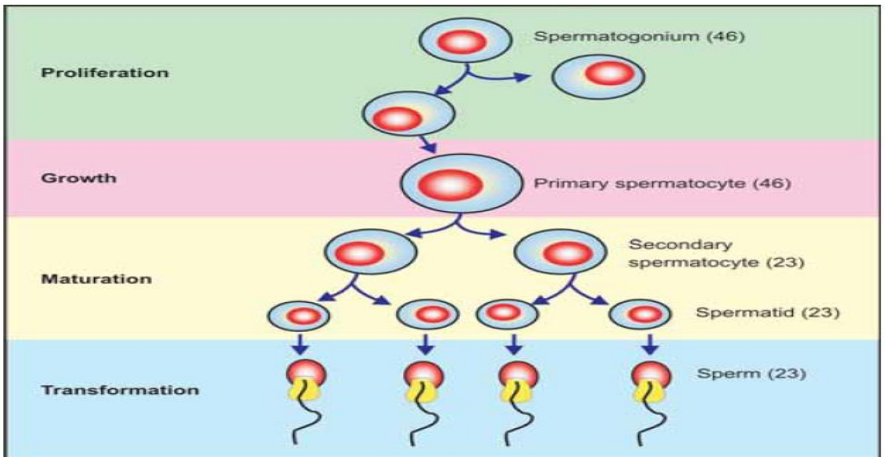
The Male reproductive system

The testes are made up of loops of convoluted seminiferous tubules. In the walls of which the spermatozoa are formed from the primitive germ cells (spermatogenesis).. Between the tubules of testes there are cells containing lipid granules called **interstitial cells of Leydig** which secrete **testosterone.**

The Sertoli cells secrete:

I. **Mullerian inhibiting substance (MIS)**
2. **Inhibin** that inhibit FSH secretion.
3. **Androgen binding protein**
4. **Estrogen** is produced as Sertoli cells contain (aromatase) the enzyme responsible for conversion of androgen to estrogen.

Spermatogenesis: Spermatogenesis follows the following steps: Spermatogonin (primitive germ cell at basal lamina) ➔ primary spermatocytes ➔ secondary spermatocytes ➔ spermatids ➔ spermatozoa (sperm).



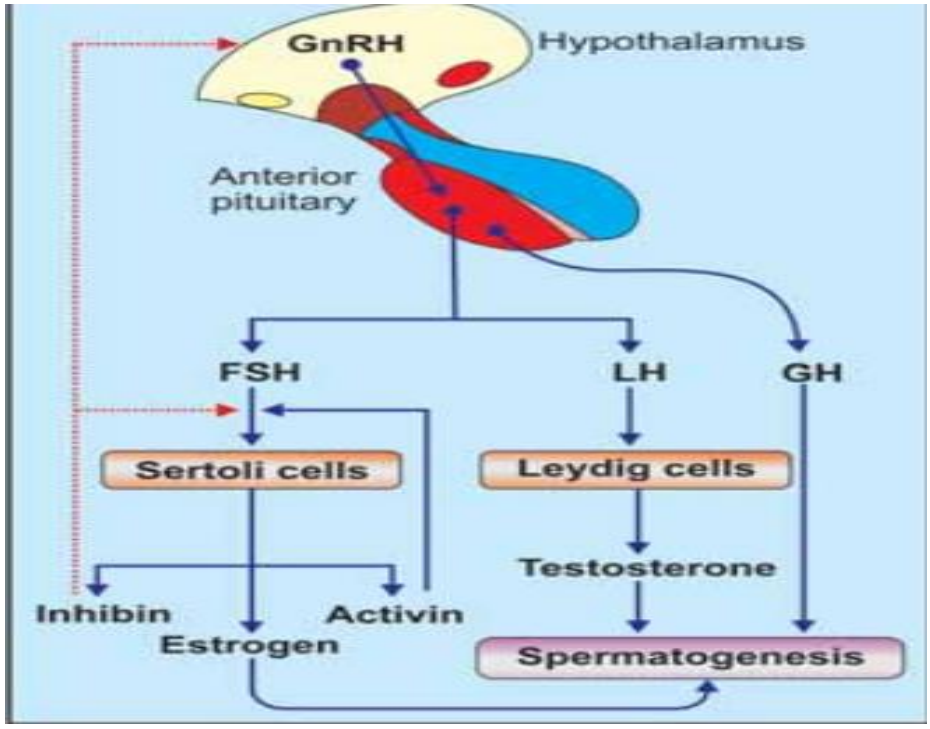
Spermatogenesis. Number in parenthesis indicate chromosomal number

Several hormones play essential roles in spermatogenesis:

1. **Testosterone:** necessary for maturation of spermatids to spermatozoa.
2. **FSH:** [1] Acts on Sertoli cell to facilitate last step of spermatid maturation. [2] Stimulates production of ABP.
3. **LH:** stimulates the production of androgen from interstitial cells of Leydig.
4. **Estrogen.**
5. **Growth hormones:** necessary for controlling background metabolic function of testes and promote early maturation of spermatogonia.

5-Inhibin: Inhibin inhibits FSH secretion through feed-back mechanism leading to decrease in the pace of spermatogenesis

6-activin: Activin has opposite actions of inhibin. It increases secretion of FSH and accelerates spermatogenesis.



Role of hormones in spermatogenesis

Function of Testosterone:

Functions of Testosterone in Adult Life

Testosterone has two important functions in adult:

1. Effect on sex organs
2. Effect on secondary sexual characters.

The secondary sexual characters in males are:

1-Effect on muscular growth Testosterone increases the muscle mass due to its anabolic effects on proteins.

2-Effect on bone growth After puberty, testosterone increases the thickness of bones by increasing the matrix content and calcium deposition.

3-Effect on skin Testosterone increases the thickness of skin and ruggedness of subcutaneous tissue by increasing the deposition of proteins in skin

4-Effect on hair distribution the testosterone causes male type of hair distribution on the body,

5-Effect on voice, At the time of adolescence, the boys have a cracking voice

6-Effect on basal metabolic rate

7-Effect on electrolyte and water balance, Testosterone increases the sodium reabsorption from renal tubules along with water

8-Effect on blood, Testosterone has got erythropoietic action. So, after puberty, testosterone causes mild increase in RBC count.

Female reproductive system

The reproductive system of the female, unlike that of the male, shows regular (Cyclic) rhythmical changes in the rate of secretion of female hormones and corresponding changes in ovaries and sexual organs, which may be regarded as periodic preparation for fertilization and pregnancy.

Ovarian hormone

Ovary secretes the female sex hormones estrogen and progesterone. Ovary also secretes few more hormones namely, inhibin, relaxin and small quantities of androgens.

Estrogen

In a normal nonpregnant female, estrogen is secreted in large quantity by theca interna cells of ovarian follicles and in small quantity by corpus luteum of the ovaries. A small quantity of estrogen is also secreted by adrenal cortex. In pregnancy, a large amount of estrogen is secreted by the placenta.

Functions of Estrogen

The major function of the estrogen is to promote cellular proliferation and tissue growth in the sexual organs and in other tissues related to reproduction.

Effects of estrogen are:

Effect on ovarian follicles

Effect on uterus

Effect on fallopian tubes

Effect on vagina

Effect on secondary sexual characters

Effect on breast

Effect on bones

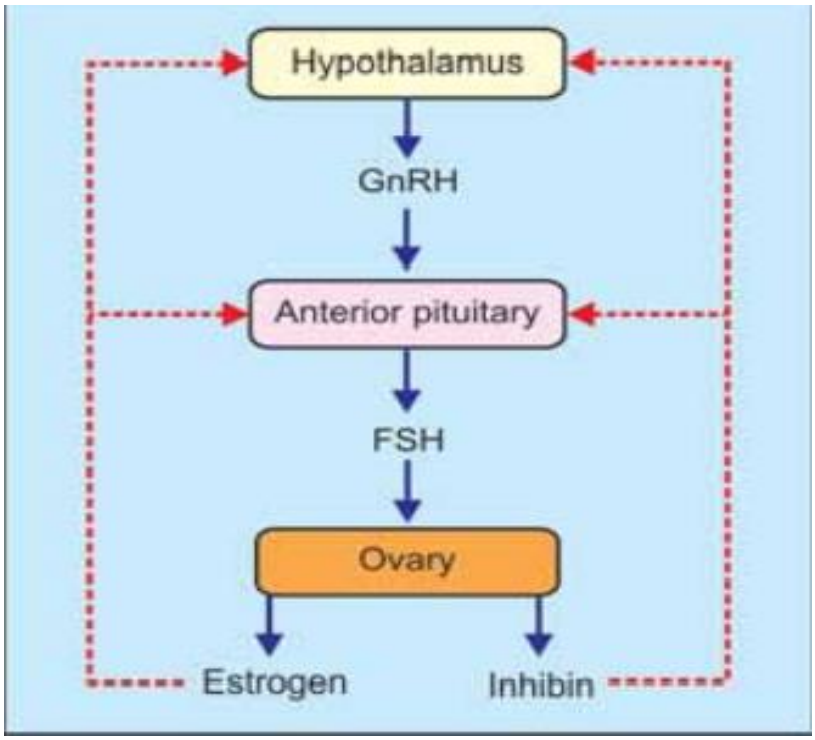
Effect on metabolism

Regulation of Estrogen Secretion

The secretion of estrogen is regulated by FSH released from anterior pituitary. The release of FSH is stimulated by gonadotropic releasing hormone (GnRH) secreted from hypothalamus.

FSH stimulates the secretory activities of theca and granulosa cells. Estrogen inhibits secretion of FSH and GnRH by negative feedback. Inhibin secreted by

granulosa cells also decreases estrogen secretion by inhibiting secretion of FSH and GnRH .



Regulation of estrogen secretion.
Red dashed lines indicate inhibition

Progesterone

A small quantity of progesterone is secreted by theca interna cells of ovaries during the first half of menstrual cycle, i.e. during follicular stage. But, a large quantity of progesterone is secreted during the latter half of each menstrual cycle, i.e. during secretory phase by the corpus luteum.

Small amount of progesterone is secreted from adrenal cortex also. During pregnancy, large amount of progesterone is secreted by the corpus luteum in the first trimester. In the second trimester corpus luteum degenerates. Placenta secretes large quantity of progesterone in second and third trimesters.

Functions of Progesterone

Progesterone is concerned mainly with the final preparation of the uterus for pregnancy and the breasts for lactation. The effects of progesterone are:

1. Effect on fallopian tubes
2. Effect on uterus
3. Effect on cervix
4. Effect on mammary gland
5. Effect on hypothalamus
6. Thermogenic effect
7. Effect on respiration
8. Effect on electrolyte balance

Regulation of Secretion of Progesterone

LH from anterior pituitary activates the corpus luteum to secrete progesterone. Secretion of LH is influenced by the gonadotropic releasing hormone secreted in hypothalamus. Progesterone inhibits release of LH from anterior pituitary by negative feedback.

Ovarian (menstrual) cycle

Ovarian cycle has 3 phases:

[A] The first phase: The Follicular phase: The first day of bleeding is regarded as first day of the cycle. The follicular phase extends from the 5^{th} day of the cycle to the 14^{th} day during which FSH will induce maturation of the primordial follicles ➔ vesicular follicles ➔ mature follicles (called Graffian follicles). Many follicles start to mature but only one follicle reaches

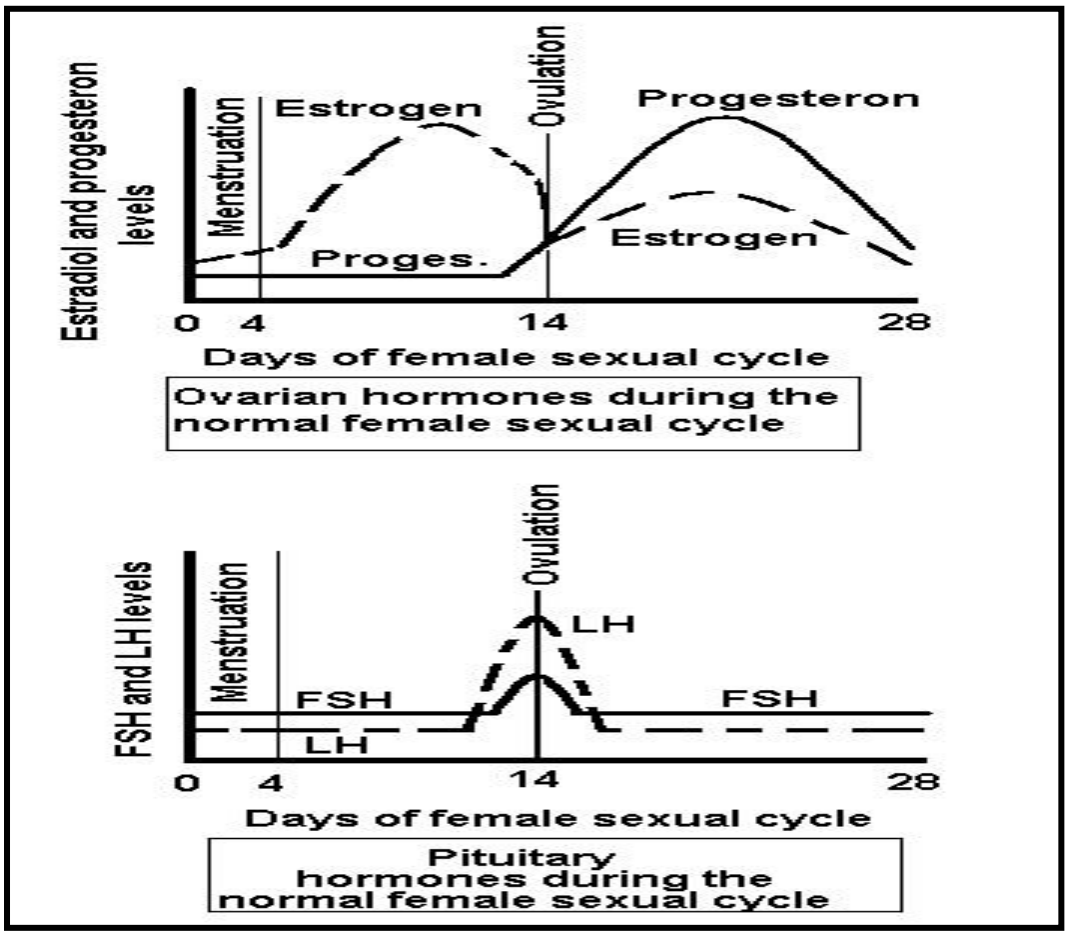
maturation per cycle. The Graffian follicle contains 3 layers, theca externa, theca interna and granulosa layer with the follicular fluid inside the antrum which contains the estrogen secreted by theca interna and granulosa under the influence of FSH. The main source of circulating estrogen is the theca interna while the granulosa cells mainly form the estrogen in the antral fluid.

[B] The second phase: Ovulation: Ovulation: Ovulation is the process in which there is rupture of graafian follicle with consequent discharge of ovum into abdominal cavity. This occurs after the maturity of follicle. It is influenced by LH. The ovulation occurs usually on 14th day of menstrual cycle in a normal cycle of 28 days. The ovum enters the fallopian tube.

[C] The third phase:

Luteal phase: Begins from the 14^{th} –28^{th} day of the cycle, <u>under the control of LH.</u>

The high levels of estrogen, progesterone and inhibin lead to – ve feedback so result in low FSH and LH. The ruptured follicle is filled with blood forming corpus haemorrhagicum. Minor bleeding from the rupture follicle in to the abdominal cavity causes lower abdominal pain due to peritoneal irritation which may be severe and misdiagnosed as acute appendicitis. The theca cells and granulosa cells start to proliferate and blood inside the corpus haemorrhagicum is replaced by luteal cells forming <u>mature corpus luteum</u>. <u>Luteal cells secrete estrogen and progesterone.</u> If pregnancy occur, corpus luteum will persist and no menstruation occur till pregnancy is over. If pregnancy does not occur, corpus luteum will degenerate in the 24^{th} day of the cycle forming <u>regressed corpus luteum</u> and then replaced by scar forming corpus albicans


Estradiol and progesteron levels
Menstruation
Estrogen
Ovulation
Progesteron
Proges.
Estrogen
0
4
14
28
Days of female sexual cycle
Ovarian hormones during the normal female sexual cycle
FSH and LH levels
Menstruation
Ovulation
LH
FSH
FSH
LH
0
4
14
28
Days of female sexual cycle
Pituitary hormones during the normal female sexual cycle