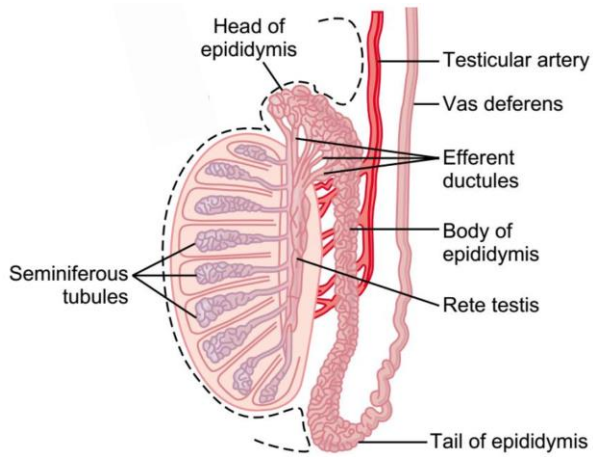
Animal physiology- /2022-2023/2nd semester

Lecture 6

Male reproductive system

Testes

The testes are suspended outside the abdomen in the scrotum. In the testes, there are many tiny, convoluted seminiferous tubules, the combined length of which is 250 m. Each seminiferous tubule is bounded by a basement membrane. In the center of each tubule is a fluid-filled lumen containing spermatozoa. The tubular wall is composed of developing germ cells, and Sertoli cells. The Leydig cells**,** lie in small connective tissue spaces between the tubules, secrete testosterone (fig.7-1)



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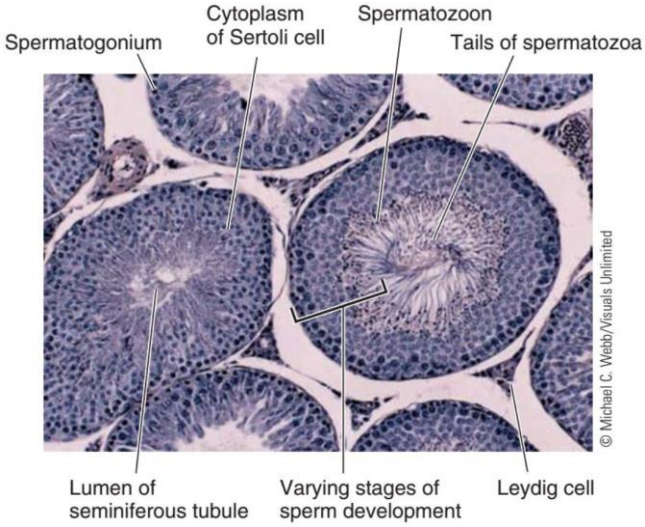

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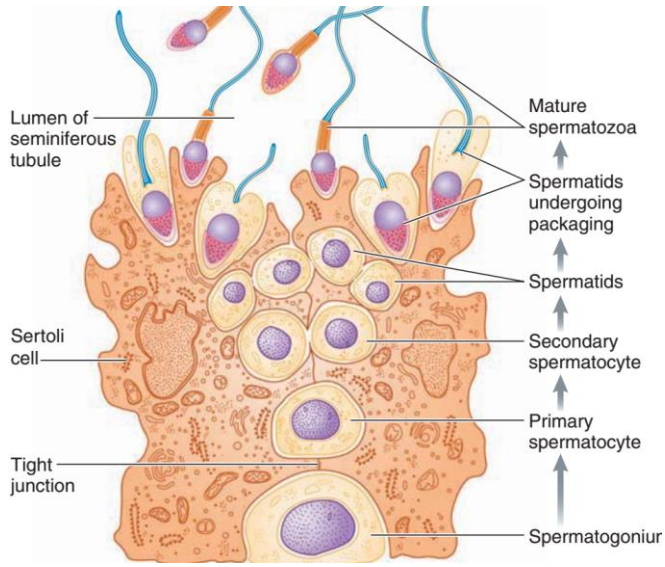

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Figure 7-1: a- Longitudinal section of testis showing location and arrangement of seminiferous tubules. b- Light micrograph of cross section of seminiferous tubules. c- Relationship of Sertoli cells to developing sperm cells.

Endocrine function of testes

The testes secrete male sex hormones, which are collectively called androgens, including testosterone and androstenedione. Testosterone is so much more abundant than the other hormone. Although much, if not most, of the testosterone is eventually converted into the more active hormone dihydrotestosterone in the target tissues.Testosterone is formed by the Leydig cells, which lie in the interstices between the seminiferous tubules (fig.7-2, fig.7-3).

Regulation of testosterone secretion

Testosterone is secreted by the Leydig cells in the testes, but only when they are stimulated by LH from the anterior pituitary gland. Furthermore, the quantity of testosterone secreted increases approximately in direct proportion to the amount of LH available. The secretion of LH is inhibited mainly by testosterone (fig.7-3).

Effects of testosterone

1-By negative feedback mechanism inhibit LH secretion directly, and indirectly through inhibition of GnRH, inhibit LH and FSH secretion

2-Causes prenatal differentiation of wolffian ducts and external genitalia (if 5α– reductase is present)

3-Induces male secondary sex characteristics.

(In humans, secondary sex characteristics include enlarged breasts and widened hips of females, facial hair and Adam's apples on males, and pubic hair on both).

4- causes pubertal growth spurt

5- Required for spermatogenesis (via sertoli cells) (fig.7-4).

6-Increases size and secretory activity of epididymis, vas deference, prostate gland, and seminal vesicles (if 5α– reductase is present)

7- Increases libido

8- May enhance aggressive behavior

9- Increases bone matrix and causes calcium retention

10- Increases basal metabolic rate

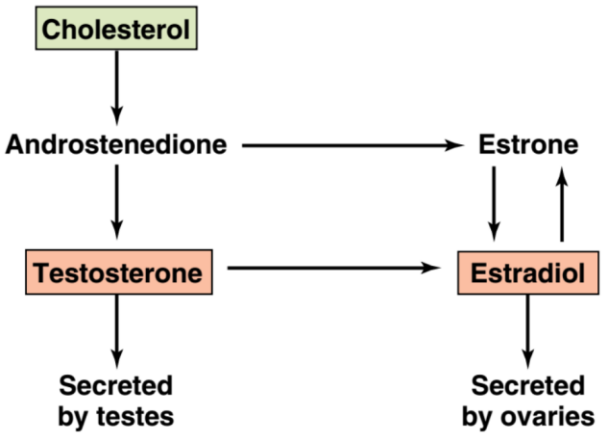

Figure 7-2: Gonadal production of steroids. Only the ovaries have high concentrations of the enzymes (aromatase) required to produce the estrogens estrone and estradiol.

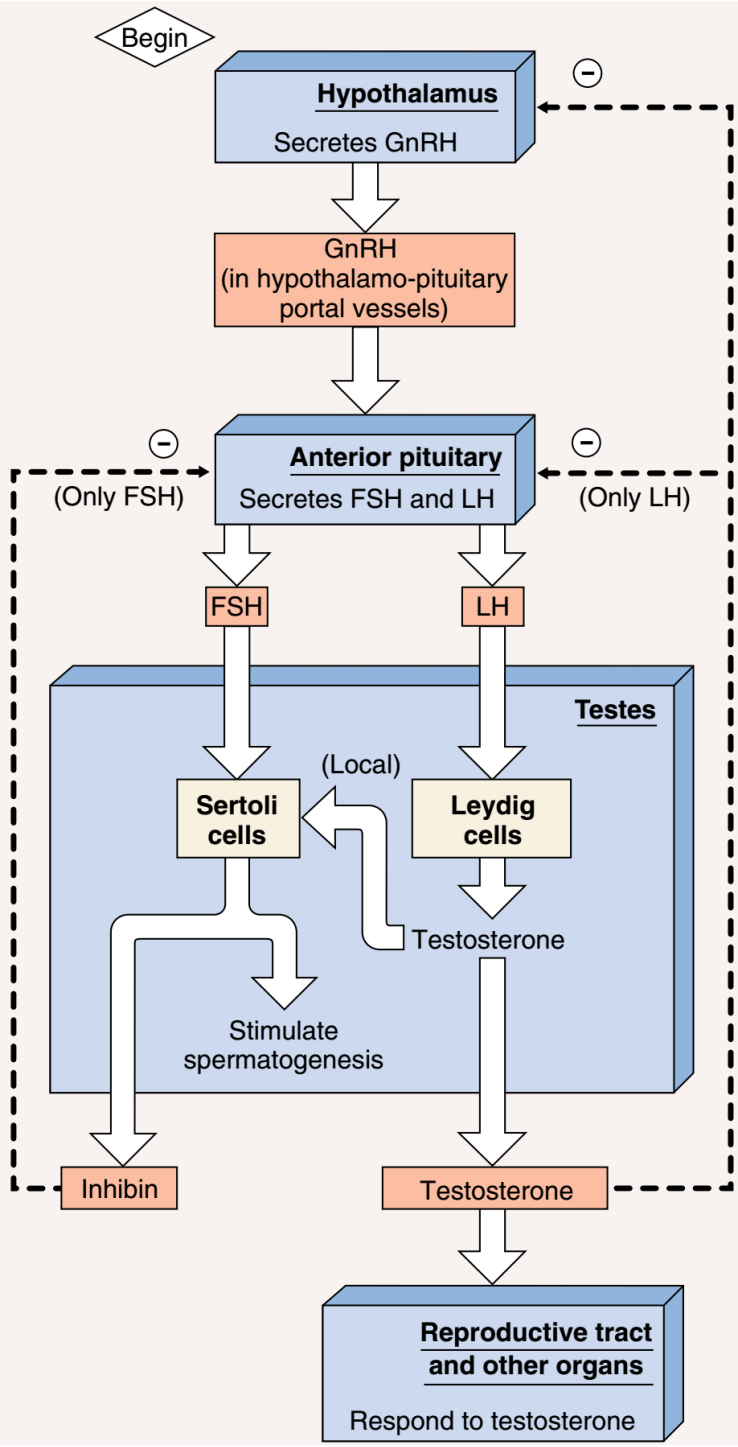

Figure 7-3: Hormonal control of male reproductive function. Note that FSH acts on the Sertoli cells, LH acts on the Leydig cells. The secretion of FSH is inhibited mainly by inhibin, a protein hormone secreted by the Sertoli cells, and the secretion of LH is inhibited mainly by testosterone, the hormone secreted by the Leydig cells. Testosterone, acting locally, is essential for spermatogenesis.

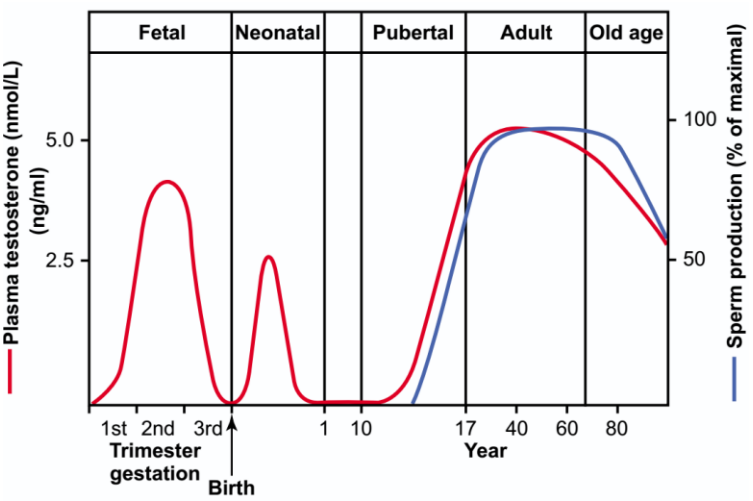

Figure7-4: The different stages of male sexual function as reflected by averageplasma testosterone concentrations (red line) and sperm production (blue line) at different ages.

Spermatogenesis

There are 2 types of cells in the seminiferous tubules. These are germ cells that progress from spermatogonia to spermatozoa and sertoli cells play supporting role during spermatogenesis. Sertoli cells which extend from the basement membrane to the lumen, envelope the germ cells and remain in contact until the spermatozoa are released into the lumen. Adjacent sertoli cells form a tight junction that serves as a blood-testis barriers, regulating the movement of constituents from blood into the seminiferous tubules (fig.7-1)).

Spermatogenesis can be divided into 3 phases (fig.7-5).

1-Spermatocitogenesis, mitotic divisions during which spermatogonia form primary spermatocytes.

2- primary spermatocytes undergo meiosis forming spermatids with haploid nuclei.

3-Spermiogenesis, spermatids undergo a metamorphosis, forming spermatozoa.

The entire process will be completed in 46-49 days in rams, boar 36-40 days, stallion 55-59 days, bulls 56-63 days, and for human ---- days (fig.7-6).

Hormonal factors that stimulate spermatogenesis

several hormones play essential roles in spermatogenesis. Some of these are as follows:

I-Testosterone, secreted by the Leydig cells located in the interstitium of the testis, is essential for growth and division of the testicular germinal cells, which is the first stage in forming sperm (fig. 7-4).

2-LH, secreted by the anterior pituitary gland, stimulates the Leydig cells to secrete testosterone.

3-FSH, also secreted by the anterior pituitary gland, stimulates the Sertoli cells;

without this stimulation, the conversion of the spermatids to sperm (the process of spermiogenesis) will not occur.

4-Estrogens, formed from testosterone by the Sertoli cells when they are stimulated by follicle stimulating hormone, are probably also essential for spermiogenesis.

5-Growth hormone (as well as most of the other body hormones) is necessary for controlling background metabolic functions of the testes. Growth hormone specifically promotes early division of the spermatogonia themselves; in its absence, as in pituitary dwarfs, spermatogenesis is severely deficient or absent, thus causing infertility.

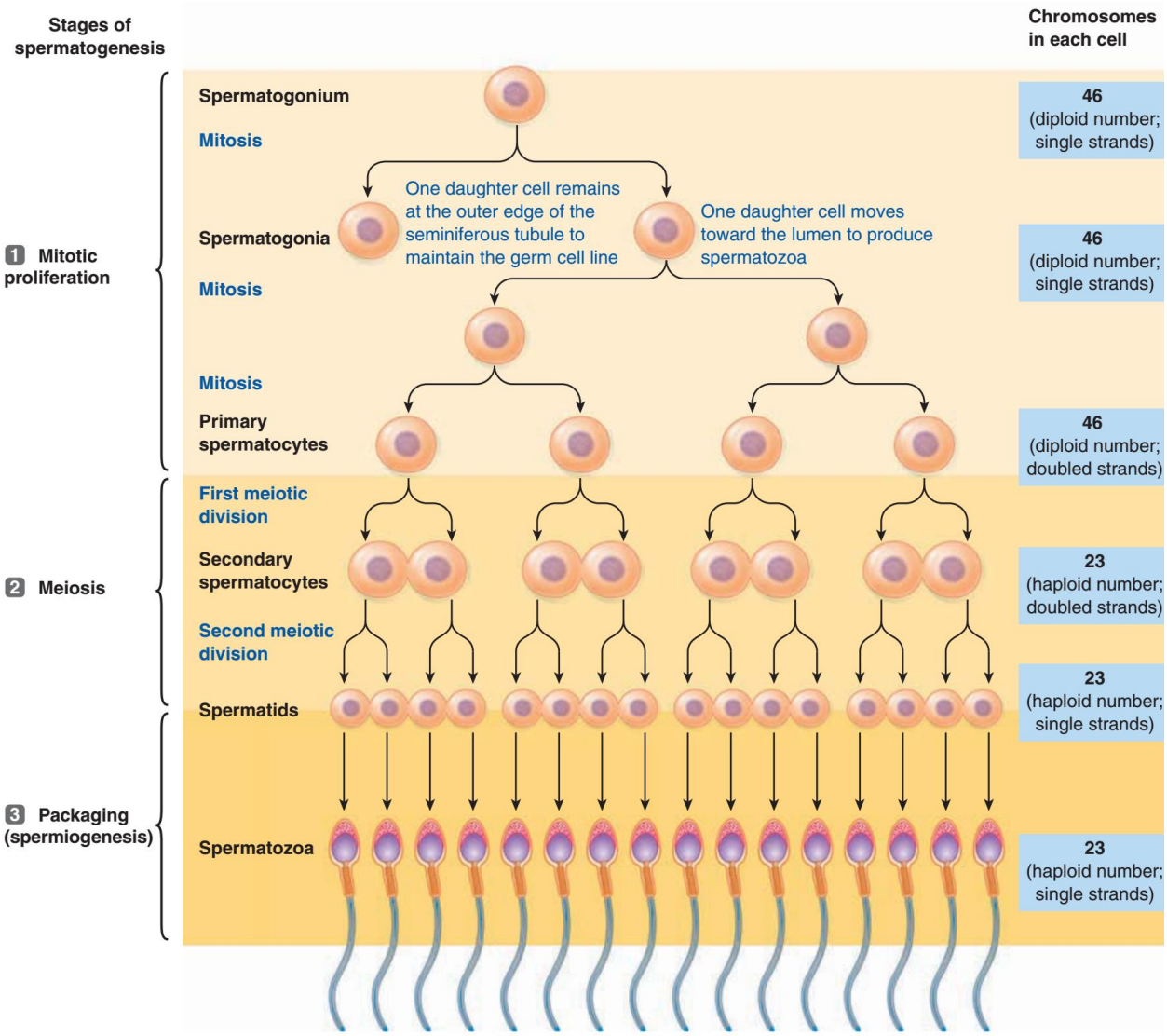

Figure 7-5: Spermatogenesis.

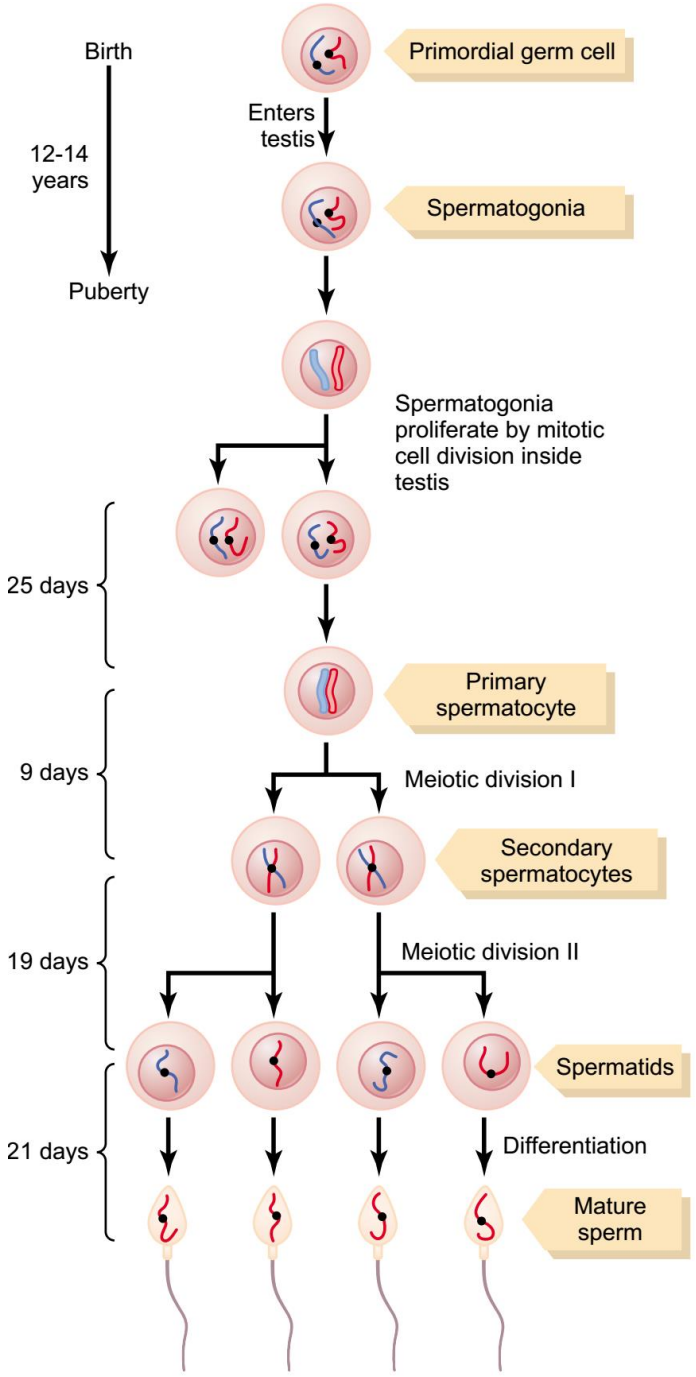

Figure 7-6: Cell divisions during spermatogenesis. Spermatogenesis occurs in the seminiferous tubules during active sexual life as the result of stimulation by anterior pituitary gonadotropic hormones. During embryonic development the primordial germ cells migrate to the testis where they become spermatogonia. At puberty (usually 12 to14 years after birth), the spermatogonia proliferate rapidly by mitosis. Some begin meiosis to become primary spermatocytes and continue through meiotic division I to become secondary spermatocytes. After completion of meiotic division II, the secondary spermatocytes produce spermatids, which differentiate to form spermatozoa.

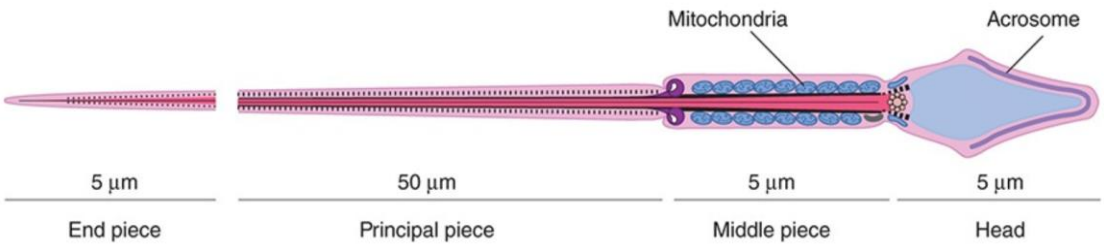

Figure 7-7: Human spermatozoon, profile view. Note the acrosome, an organelle that covers half the sperm head inside the plasma membrane of the sperm.

Semen

The fluid that is ejaculated called the semen, contains sperm and the secretions of the seminal vesicles, prostate, Cowper glands, and, probably, the urethral glands.

Questions

1- True or false: Each seminiferous tubule is about 2 meters long.

2- The mature testes perform dual function, 1---------- , 2----------.

2-In figure 7-3, explain functions of LH, FSH, and inhibin.

3- Draw C.S from seminiferous tubule with labeling.

4-Explain the role of testosterone in spermatogenesis

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