

MALE REPRODUCTIVE PHYSIOLOGY

*GUYTON & HALL,
CHAPTER 81*

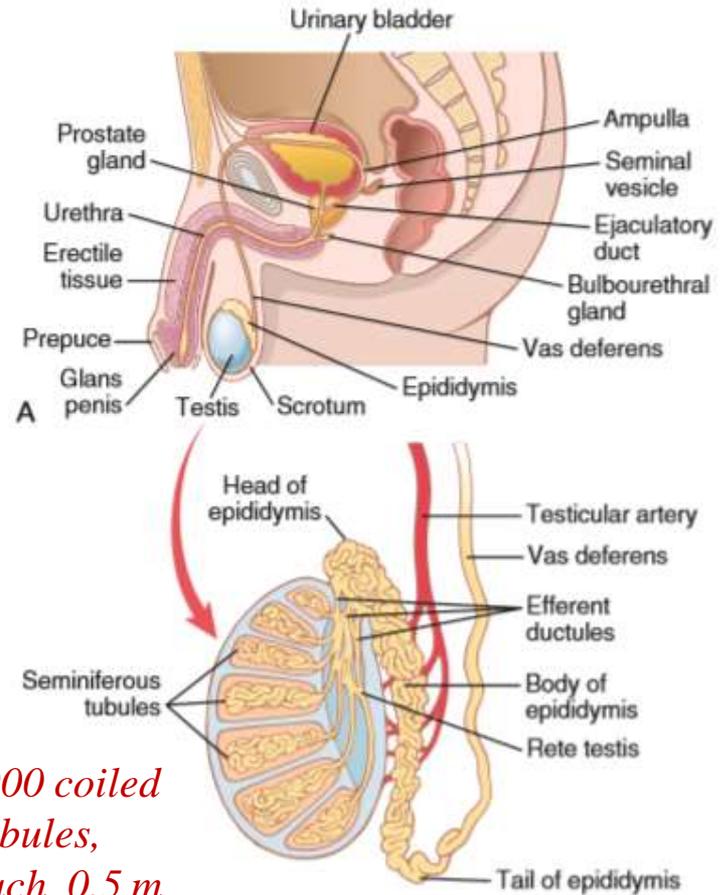
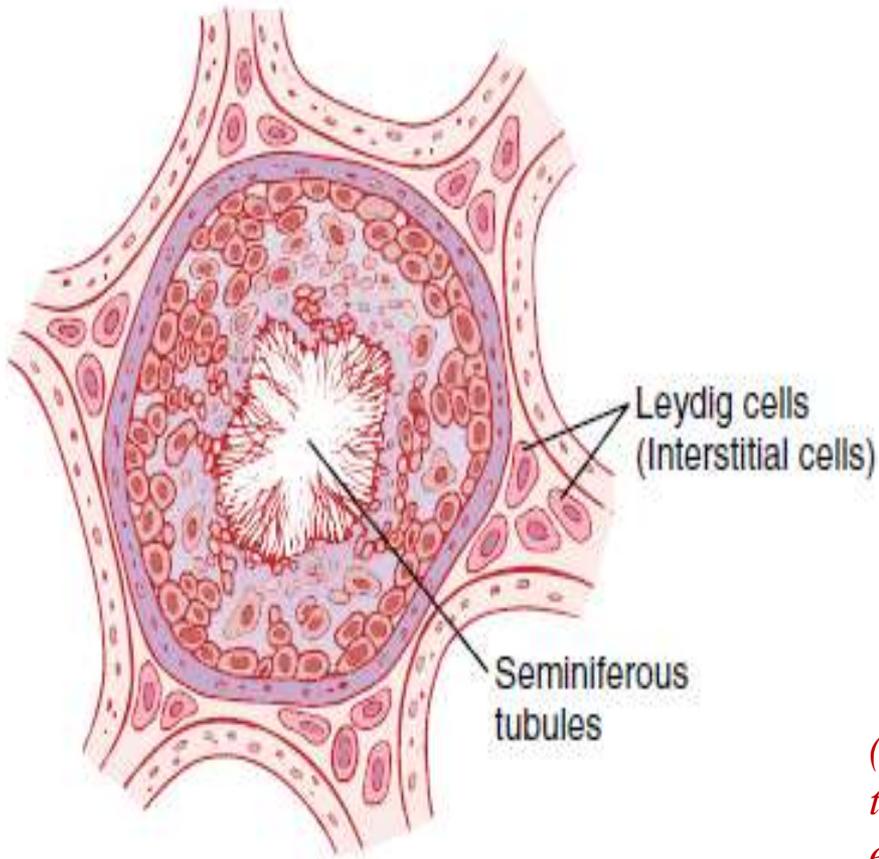
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MALE REPRODUCTIVE SYSTEM

OBJECTIVES:

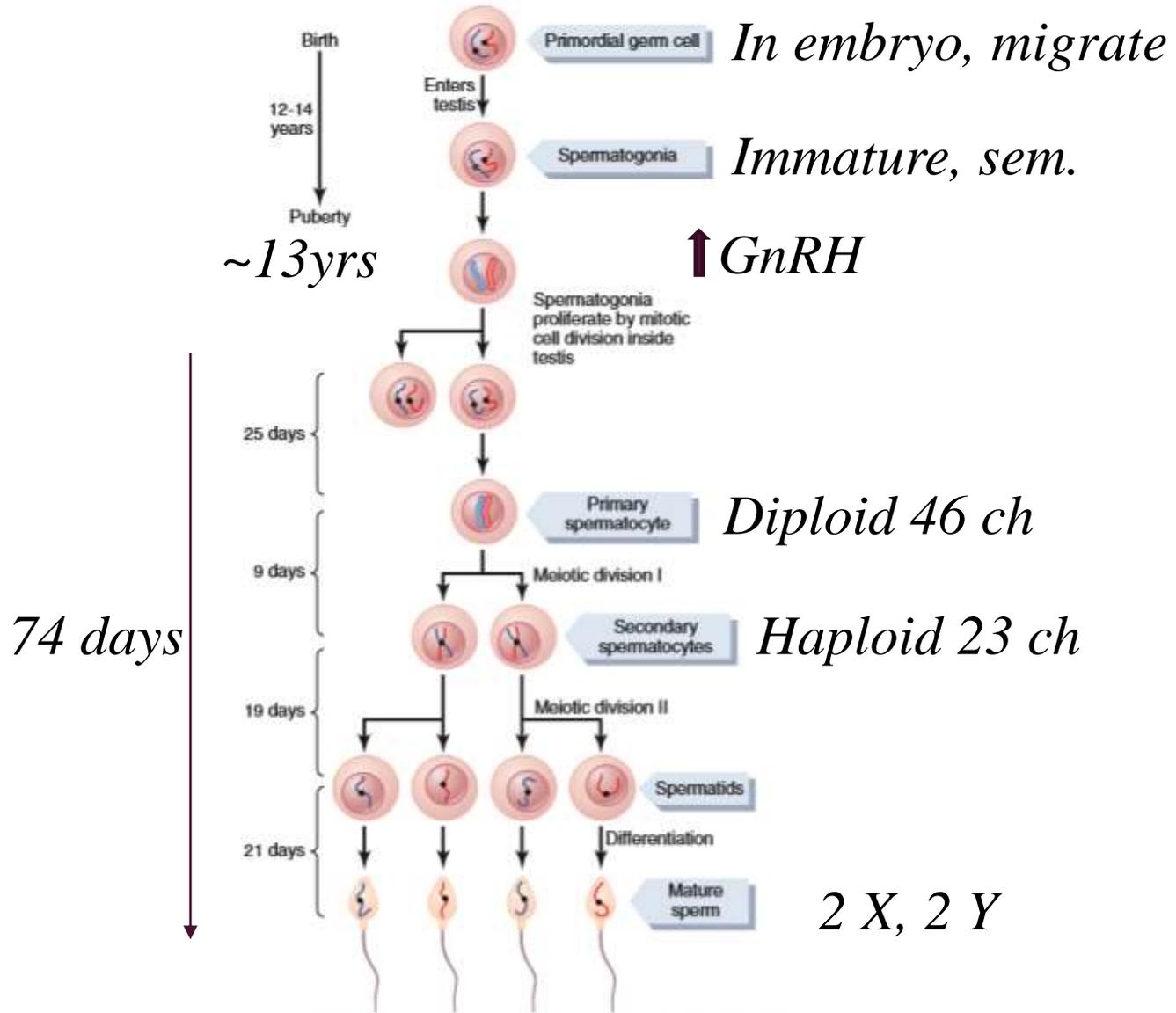
- Explain how the hypothalamus and anterior pituitary gland regulate the male reproductive function
- Explain the *spermatogenesis* and the functions of the male reproductive organs and glands
- Describe the synthesis, secretion, metabolism and the effects of testosterone
- Describe the abnormalities of male sexual function

Male Reproductive Organs

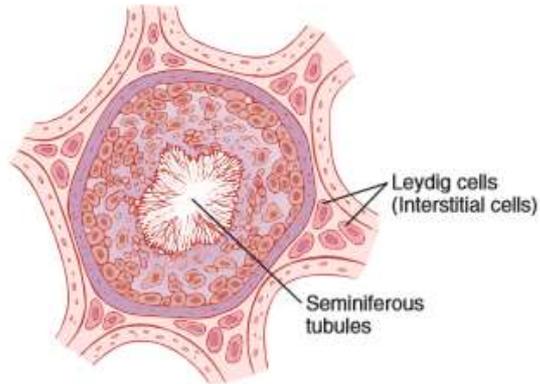


(6 m long)

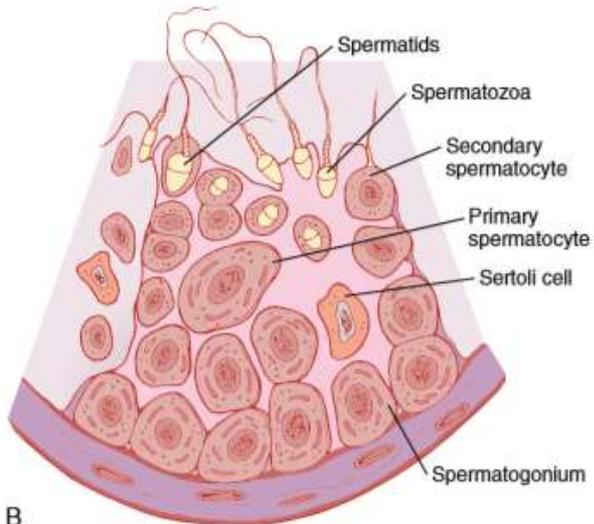
(900 coiled tubules, each 0.5 m long)



SPERMATOGENESIS



A



B

- Formation of sperm from spermatogonia.
- Occurs in seminiferous tubules influenced by GnRH.
- Starts 10-13 years old > ↓ older people, climacteric
- *Sertoli cells*: large with overflowing cytoplasmic envelopes that surround the developing spermatogonia around the central lumen of the seminiferous tubules. (nourish and support) (FSH)
- *Leydig cells*: lie with interstitium between the seminiferous tubules. (LH → testosterone)
- - numerous in the newborn male infants ONLY for the first few months of life
- - active at puberty & throughout adult life & secrete testosterone.

Hormonal factors that stimulate spermatogenesis

1-Testosterone,

by the Leydig cells for growth and division of the testicular germinal cells.

2-Luteinizing hormone,

stimulates the Leydig cells to secrete testosterone.

3-Follicle-stimulating hormone,

stimulates the Sertoli cells; without this, no spermatogenesis

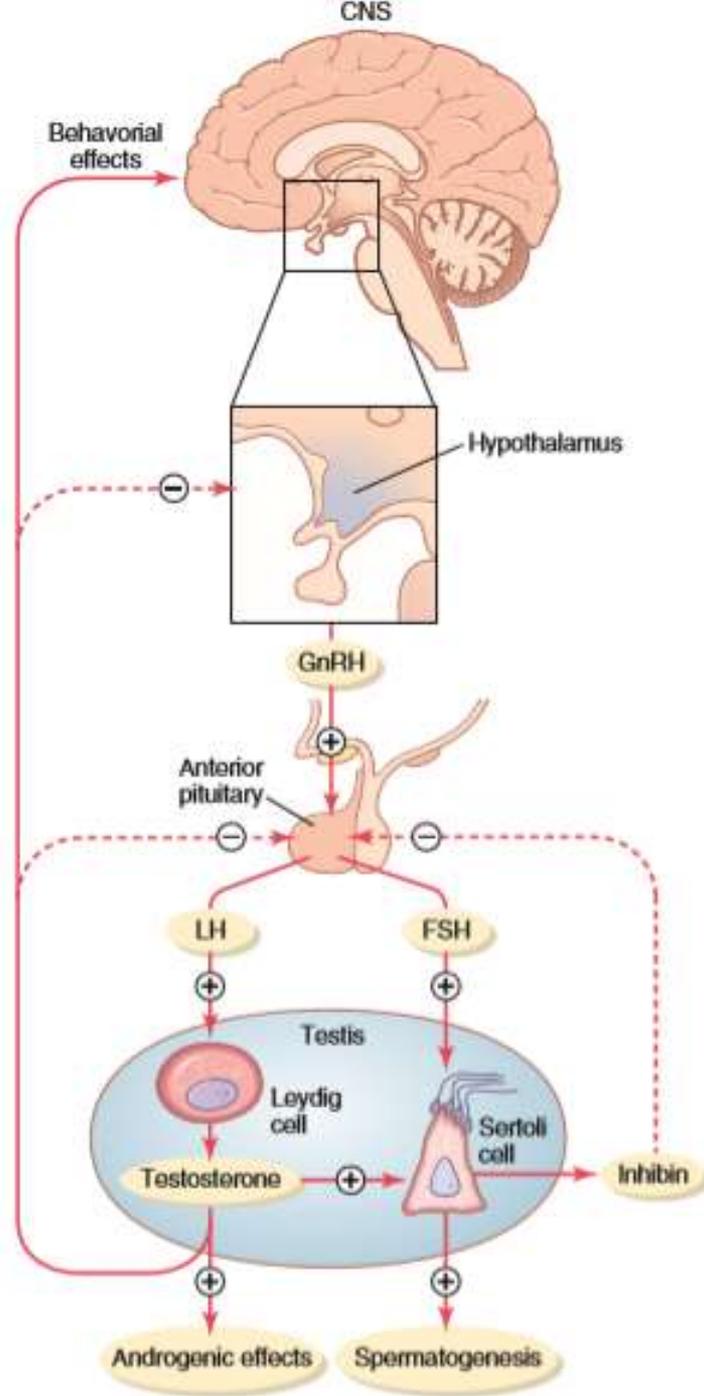
4-Estrogens

formed from testosterone by the Sertoli cells when they are stimulated by FSH hormone, are probably also essential.

5-Growth hormone,

metabolic function in testes and promotes early division of the spermatogonia themselves; in pituitary dwarfs ? spermatogenesis?

*Hypothalamic-
anterior pituitary-
gonad's axis*



PHYSIOLOGY OF MATURE SPERM:

- Mature sperm are motile & capable of fertilizing the ovum & their activity is enhanced in a neutral & slightly alkaline medium & depressed in mildly acidic medium.
- ejaculated sperm live in the female genital tract for only 1 to 2 days
- The acrosome stores large quantities of **hyaluronidase** (to digest **proteoglycans**) and **proteolytic enzymes** (to digest proteins).

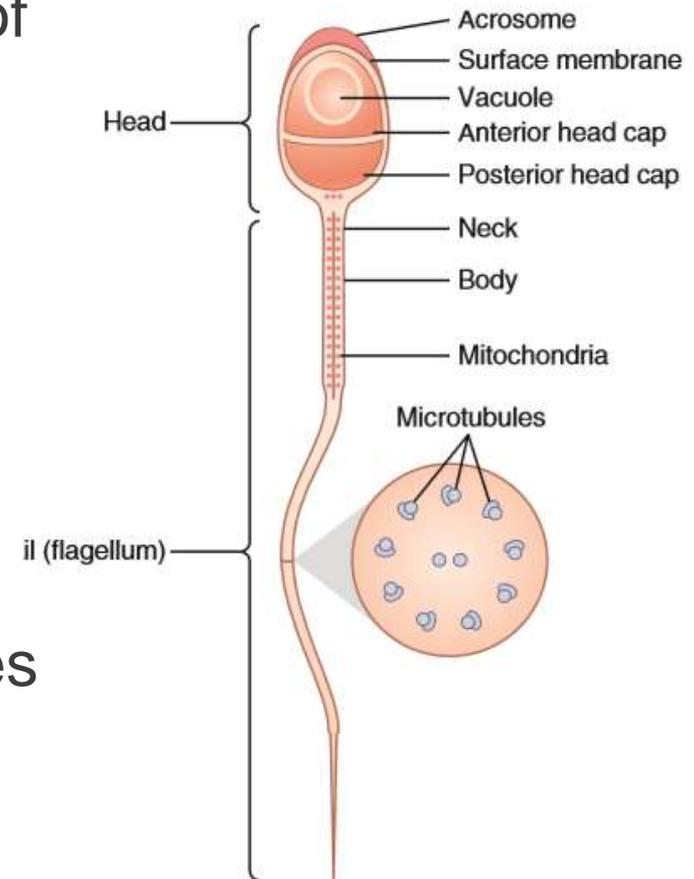


Figure 81-4. Structure of the human spermatozoon.

MATURATION OF SPERM IN THE EPIDIDYMIS

- After their formation in the seminiferous tubules, sperms require several days to pass through the epididymis (non-motile).
- After 18 to 24 hrs → they develop the capability of motility in epididymis
- (some **inhibitory proteins** in the epididymal fluid prevent final motility until after ejaculation).

STORAGE OF SPERMS

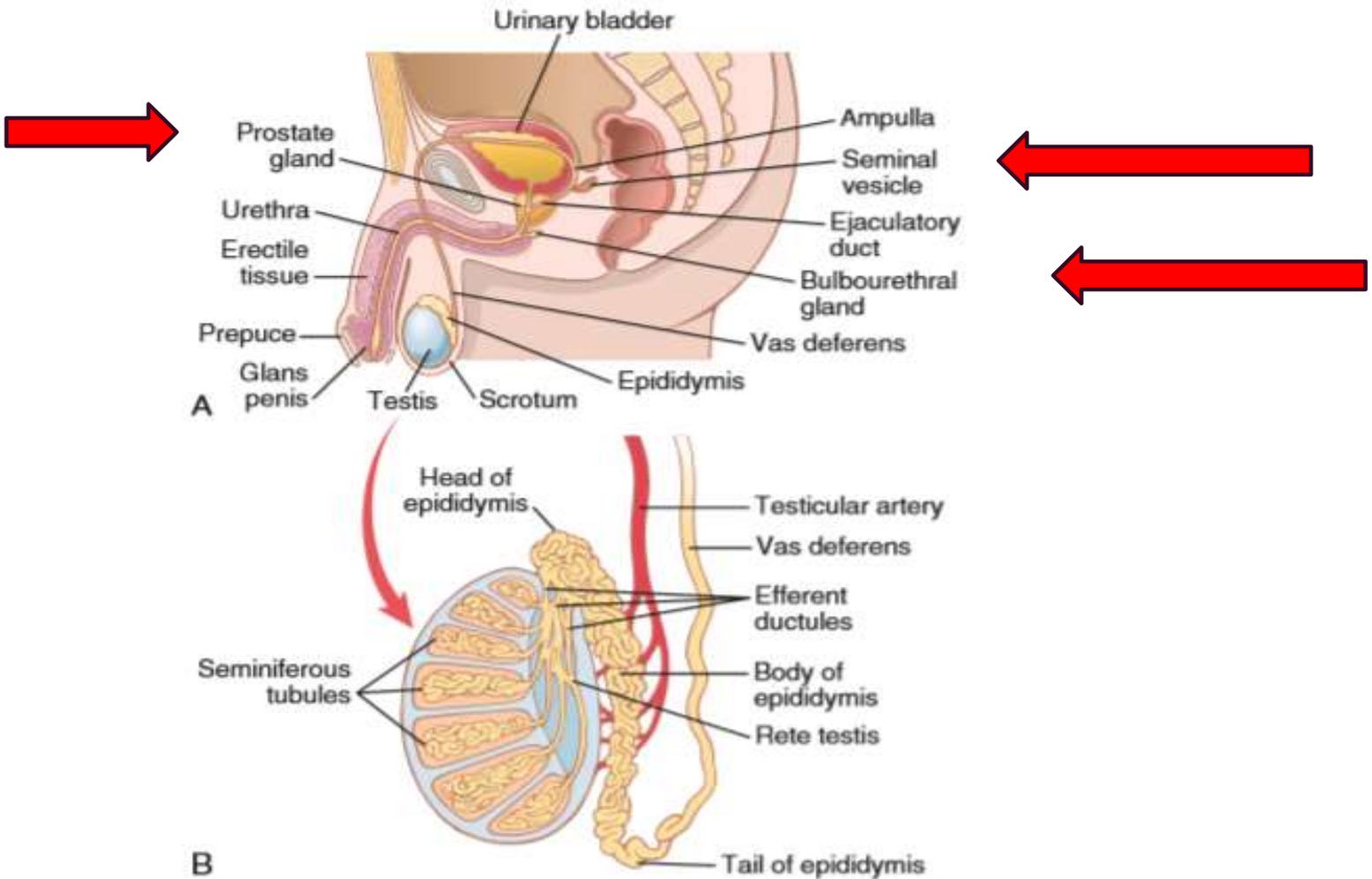
The 2 testes of adult human form up to 120 million sperms each day.

- Small amount are stored in the epididymis
- The majority are stored in the vas deferens(month).

After ejaculation, the sperm becomes motile & capable of fertilizing the ovum “maturation”

- The sertoli cells and epithelium of the epididymis secrete nutrient fluid which contains (testosterone & estrogens), enzymes & nutrients essential for sperm maturation.

SECRETION OF MALE GLANDS



Seminal Vesicles Function

– mucoïd material containing fructose, citric acid & nutrient substances & large quantities of prostaglandins & fibrinogen.

The prostaglandins help in fertilization in two ways:

1- by reacting with the female cervical mucus making it more receptive to sperm movement.

2- by causing backward reverse peristaltic contractions of the uterus & fallopian tubes to move the ejaculated sperm toward the ovaries.

Prostate Gland Function

The prostate gland secretes *thin milky fluid* containing; Ca^{2+} , citrate ion, phosphate ion, a clotting enzyme & profibrinolysin. The alkaline prostatic fluid is important for successful fertilization of the ovum.

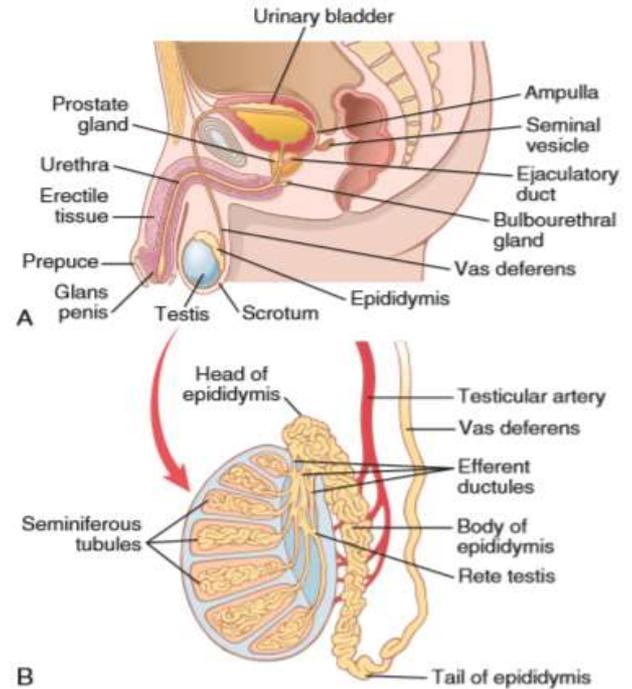
Alkaline prostate fluid function:

- 1- helps to neutralize the slightly acidic fluid of the vas deferens (due to the presence of citric acid and metabolic product of the sperm which inhibits its fertility).
- 2- helps to neutralize the acidic vaginal secretions (pH 3.5-4.0) to optimize it for better sperm motility (pH 6.0-6.5)

SEMEN

Ejaculated semen during sexual act
is composed of :

- the fluid & sperm from the **vas deferens** ($\sim 10\%$)
- fluid from the **seminal vesicles** ($\sim 60\%$)
- fluid from the **prostate gland** ($\sim 30\%$)
- small amounts from the mucous glands the **bulbourethral glands**.



Capacitation of the Spermatozoa

- Freshly ejaculated semen undergoes “**capacitation**” within 1-10 hours.
 1. inhibitory factors are washed out by uterine and fallopian fluids
 2. the sperm swims away from cholesterol vesicles(acrosome gets thinner)
 3. the membrane of the sperms becomes more permeable to Ca^{++}

- The testis secretes several male sex hormones called **androgens**; testosterone, dihydrotestosterone and androstenedione.
- Testosterone is the more abundant form while dihydrotestosterone is the more active form.
- The term “androgen” means any steroid hormone that has masculinizing effects.
- From the testes and adrenal glands. Synthesized either from cholesterol or directly from acetylcoenzyme A.

TESTOSTERONE AND OTHER MALE SEX

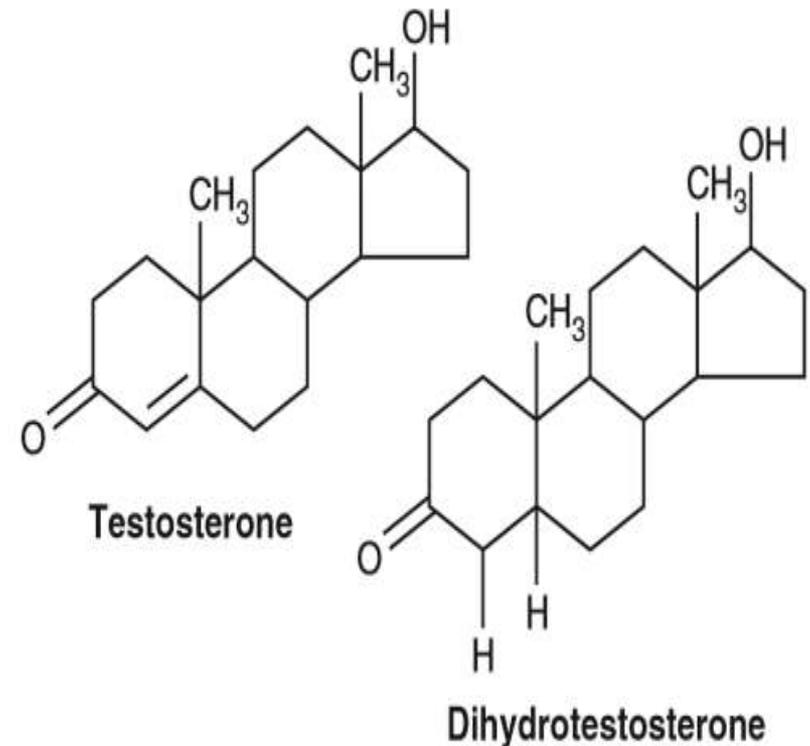
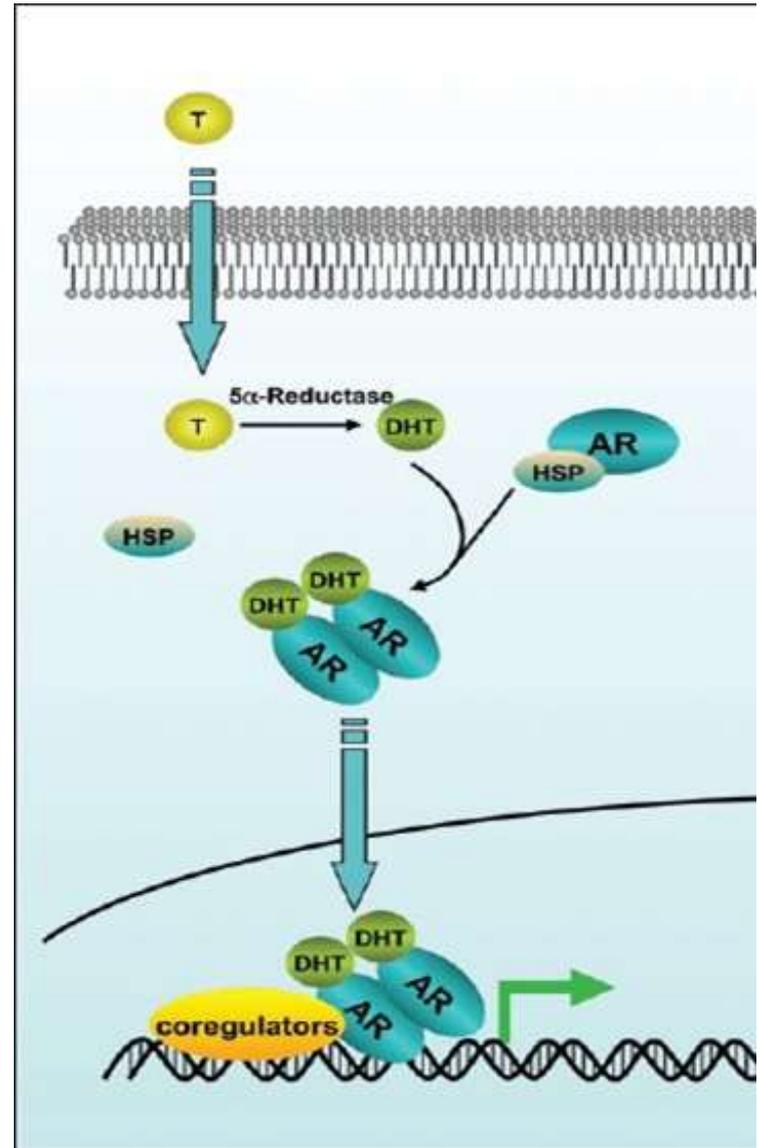


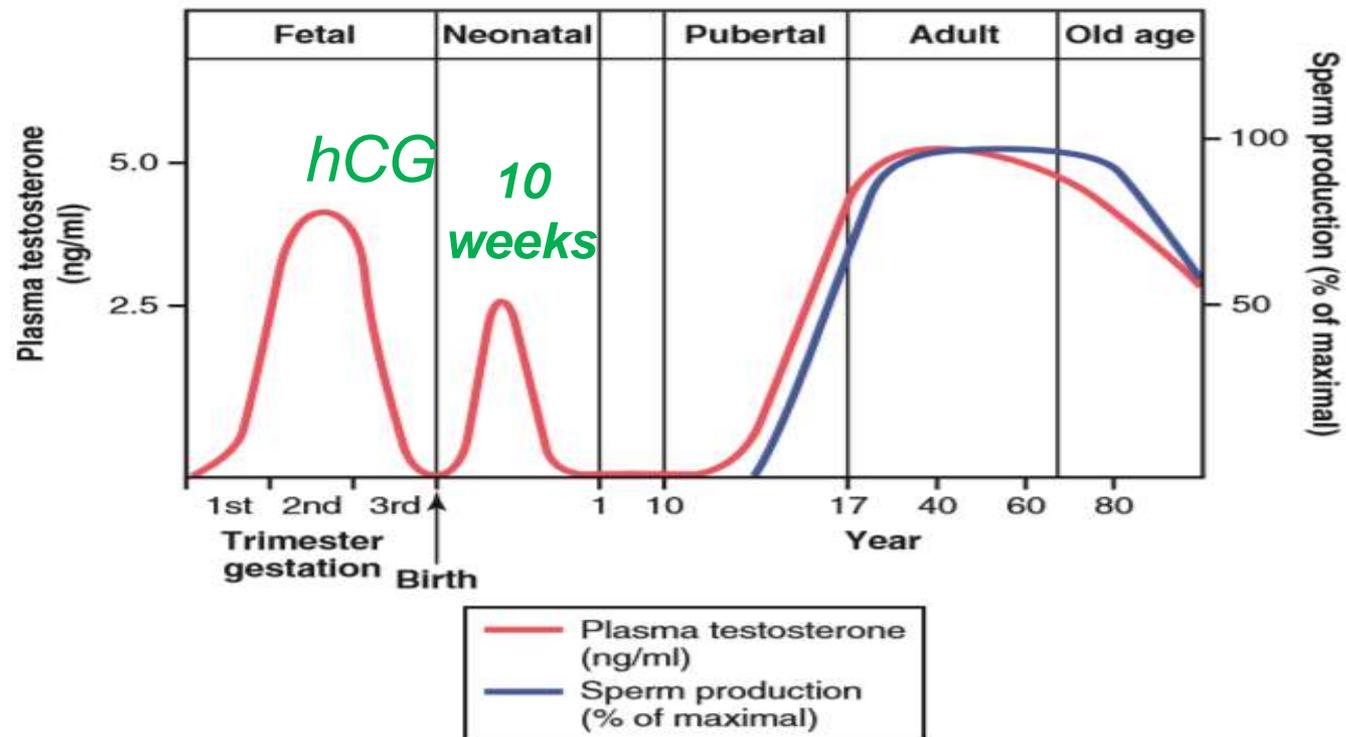
Figure 81-8. Testosterone and dihydrotestosterone.

The Intracellular mechanism of action of testosterone

It increases the rate of protein synthesis in target cells.



Functions of testosterone



- It is responsible for the characteristic masculine body of a male.

FUNCTIONS OF TESTOSTERONE DURING FETAL DEVELOPMENT

Testosterone secreted by the genital ridges & later by the fetal testes is responsible for development of the male body characteristics including the formation of penis & scrotum & suppression of the formation of female genital organs.

Effect of testosterone on descending the testis:

The testes usually descend into the scrotum during the last 2 to 3 months of gestation when the testes begin secreting reasonable quantities of testosterone.

TESTOSTERONE

Effect of
Testosterone on
Development of
Adult Primary and
Secondary Sexual
Characteristics



1- After puberty, the increasing amounts of testosterone cause enlargement of the penis, scrotum & testis & secondary sexual characteristics.

2- Effect on the distribution of body hair:

Testosterone causes growth of hair over the pubis and on the face

3- Baldness:

Testosterone decreases the growth of hair on the top of the head (two factors

1) genetic background; 2) large quantities of androgenic hormones.

4- Effect on voice:

It causes hypertrophy of the laryngeal mucosa, enlargement of the larynx (typical adult masculine voice)

5- Testosterone increases thickness of the skin and can contribute to development of acne

6- Testosterone increases protein formation and muscle development

7- Testosterone increases bone matrix and causes Ca^{2+} retention:

Bones grown thicker & deposit additional Ca^{2+} . Thus it increases the total quantity of bone matrix & causes Ca^{2+} retention (anabolic effect).

8- Testosterone increases basal metabolism:

It increases the basal metabolic rate by about 15% (indirectly as a result of the anabolic effect).

9- Effect on red blood cells:

It increases red blood cells 15-20% (due to increased metabolic rate).

10- Effect on electrolyte and water balance:

It increase the reabsorption of Na^{+} in the distal tubules of the kidneys.

MALE
REPRODUCTIVE
SYSTEM

Abnormalities of
spermatogenesis and
male sexual function

Effect of sperm count on fertility:

- The quantity of ejaculated semen during coitus is about 3-5 ml
- 1ml >>>120 million sperm (normal sperm count 35 - 200 million sperm/ml).

Effect of sperm morphology and motility on fertility:

- Sperm count is normal but infertile? abnormal shape.

■ Shape of the sperm is normal but relatively non-motile or entirely non-motile which causes infertility.



Figure 81-5. Abnormal infertile sperm, compared with a normal sperm on the right.

Prostate gland and its abnormalities

- Benign prostatic fibroadenoma in older age due to overgrowth of prostate tissue (not caused by testosterone).
- Cancer of the prostate gland caused by stimulation of cancerous cells by testosterone.

Hypogonadism in male:

- During fetal life when the testes are nonfunctional, none of the male sexual characteristics develop in the fetus. Instead female organs are formed.
- If the boy loses his testes before puberty → **eunuchism** (infantile sex organs & infantile sexual characteristics) is developed
- If a man is castrated after puberty, sexual organ regress in size and voice regress

Adiposogenital syndrome, Fröhlich syndrome, or hypothalamic eunuchism:

- Hypogonadism due to genetic inability of the hypothalamus to secrete normal amount of GnRH & abnormality of the feeding center of the hypothalamus resulting in obesity with eunuchism.



Cryptorchidism:

Failure of the testes to descend in the scrotum which normally occurs during fetal life.

Testicular tumors and hypergonadism in male:

Interstitial leydig cell tumors (rare), overproduction of testosterone.

In children, causes rapid growth of the musculature and bones and early uniting of the epiphyses and causes excessive development of male sexual organs.



SELF STUDY

MALE SEXUAL ACT



Stages of male sexual act:

1- Penile erection. by parasympathetic impulses.

2- Lubrication, Parasympathetic impulses cause the urethral glands & bulbourethral glands to secrete mucous.

3- Emission and ejaculation. Function of the sympathetic nerves.

Contraction of the vas deferens & ampulla to cause expulsion of the sperm in the internal urethra. Contraction of the prostate & seminal vesicles to expel their fluid in the urethra. All these fluid mix in the internal urethra with the mucous secreted by the bulbourethral glands to form the semen. This process at this point is called emission

- **Filling of the internal urethra** with semen causes sensory impulses through pudendal nerves to the sacral region of the cord. Fullness of the internal urethra causes rhythmical contractions of the internal genital organs which increases their pressure to ejaculate the semen to the outside called ejaculation

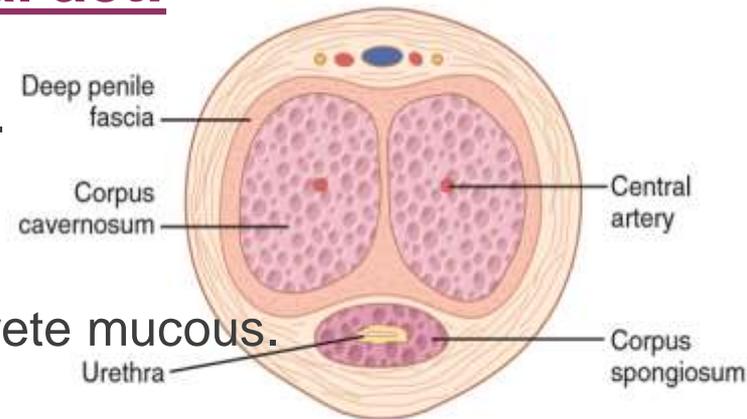


Figure 81-6. Erectile tissue of the penis.