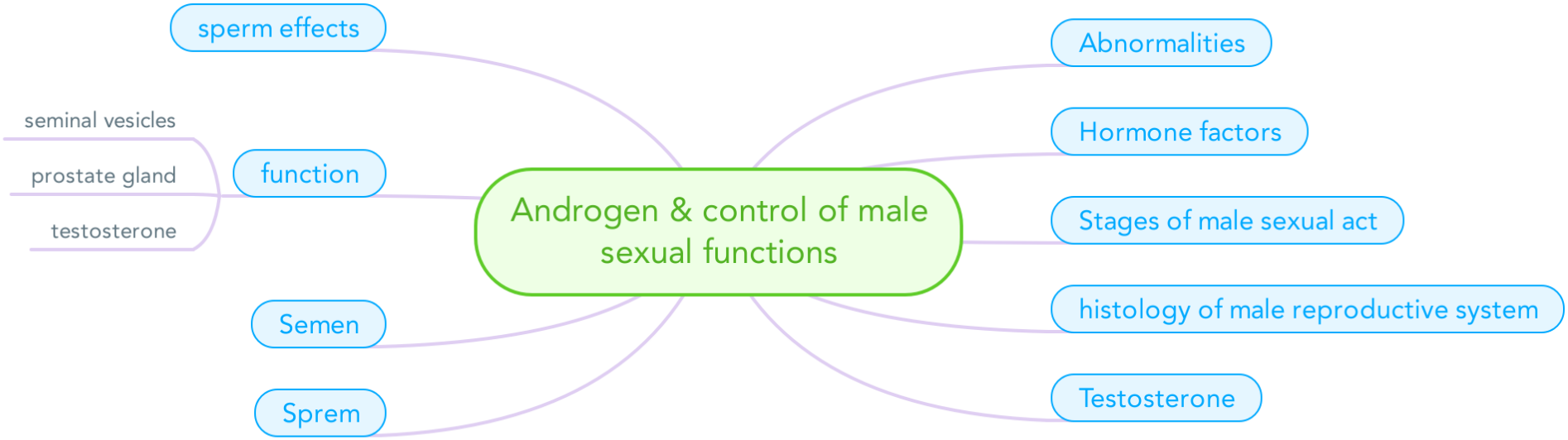
Androgen & control of male sexual functions

Reproductive Block

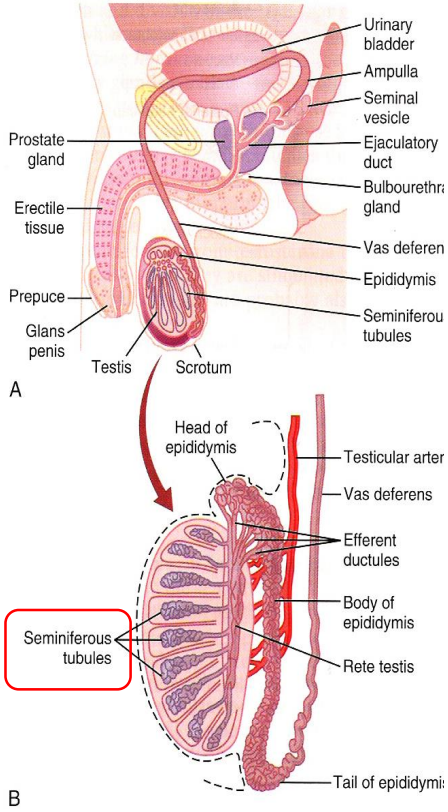
Please check out this link before viewing the file to know if there are any additions/changes or corrections
Physiology Edit File

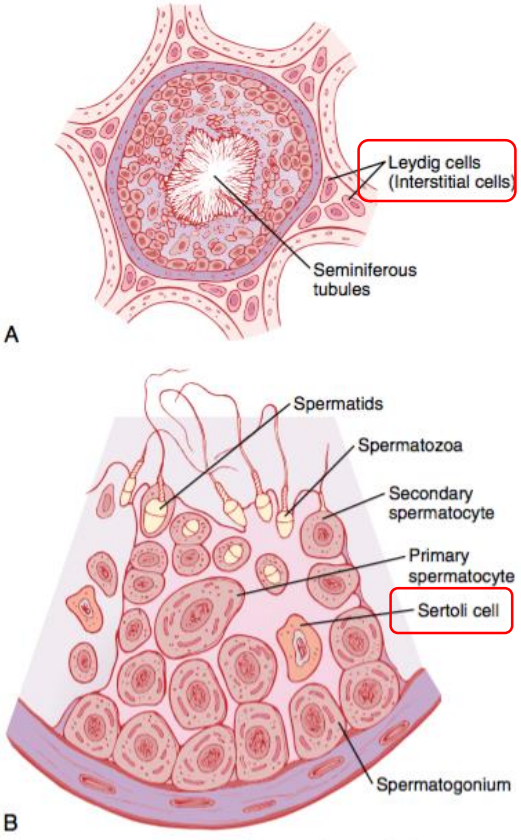
- Important
- Further explanation

Mindmap


Androgen & control of male sexual functions
sperm effects
function
seminal vesicles
prostate gland
testosterone
Semen
Sprem
Abnormalities
Hormone factors
Stages of male sexual act
histology of male reproductive system
Testosterone

Sperm





Leydig cells

- Lie within the interstice the seminiferous tubules.
- They **do not exist** in the testis during childhood almost no testosterone.
- **Numerous** in the newborn male infant for the 1st few months of life.
- **active** at puberty & throughout adult life & secrete testosterone.

Spermatogenesis

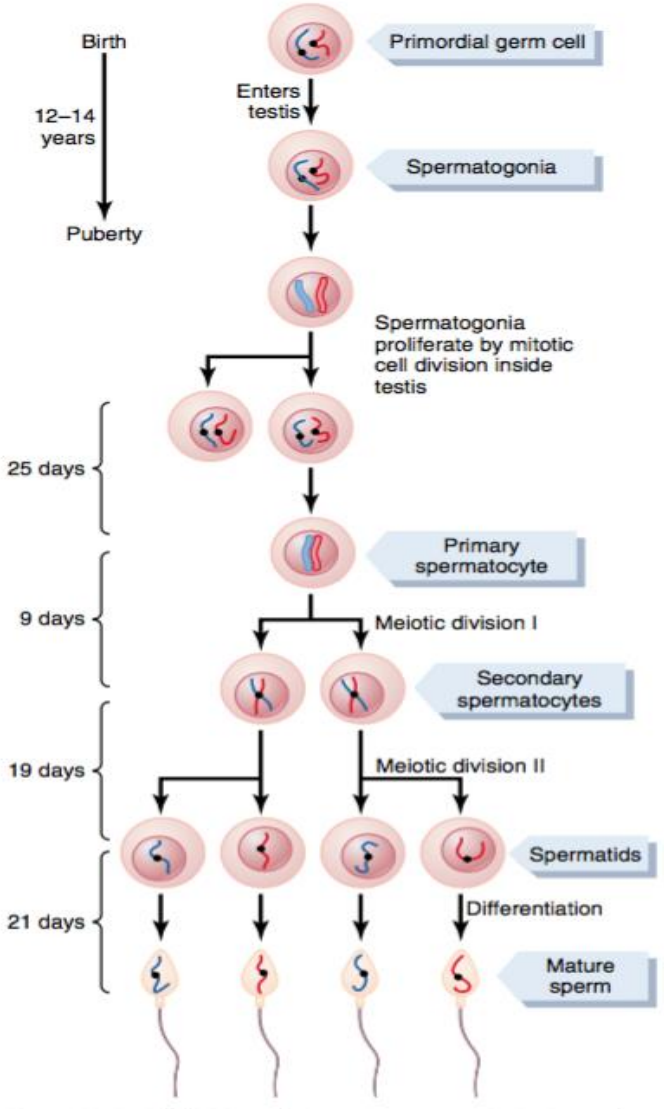
- Formation of the sperm.
- Occur in the seminiferous tubules during active sexual life → stimulation AP-GnHS.
- Begin normally at age 13.
- Continuous throughout life & decrease with age.

Sertoli cells

- large with overflowing cytoplasmic envelopes.
- Surround the developing spermatogonia around the central lumen of the seminiferous tubules

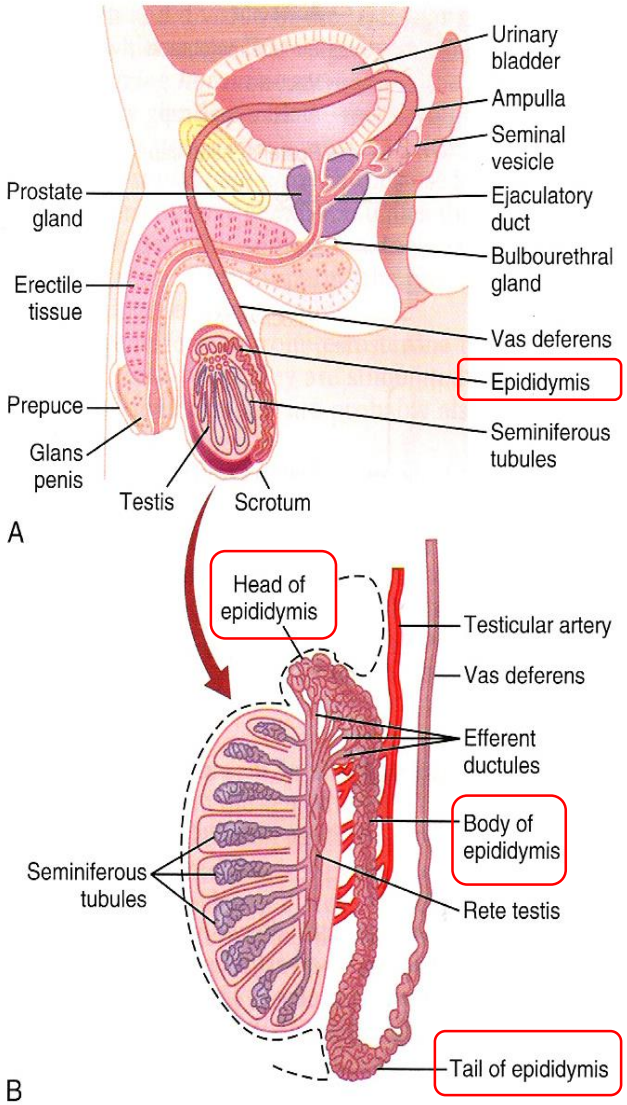
Spermatogenesis

- Occur in the seminiferous tubules



1. **Spermatogonia cross the barrier into the sertoli cell layer and become modified & enlarged to form large primary spermatocytes (mitosis).**
2. **Each of the primary spermatocyte undergoes meiotic division to form secondary spermatocytes.**
3. **Then after few days (19 days) these tow secondary spermatocyte divide as well by meiosis to form spermatids.**
4. **The spermatids eventually modified to become spermatozoa (immature sperm)**

Mitotic = mitosis (two daughter)
Meiotic = meiosis (four daughter)

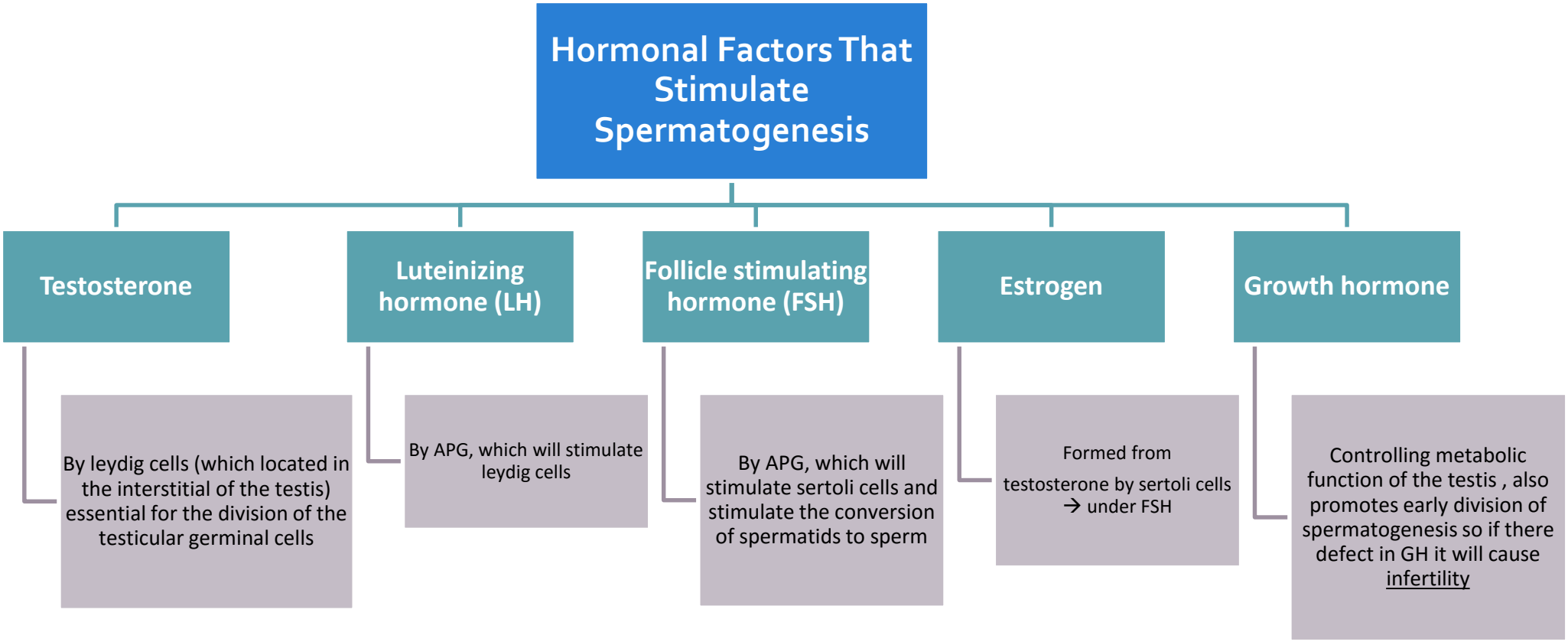


Maturation of sperm

- After formation in the seminiferous tubules, the sperm require several days to pass through the epididymis (non-motile).
- They developed the capability of motility, after they have been in the epididymis for to 18-24 hours.
- Some inhibitory proteins in the epididymis fluid prevent final motility until ejaculation.

Physiology of mature sperm

- Mature sperm are motile & capable of fertilizing the ovum.
- Their activity in enhanced in a neutral & slightly alkaline medium & depressed in mildly acidic medium.
- The life expectancy of ejaculated sperm in the female genital tract 1 to 2 days.

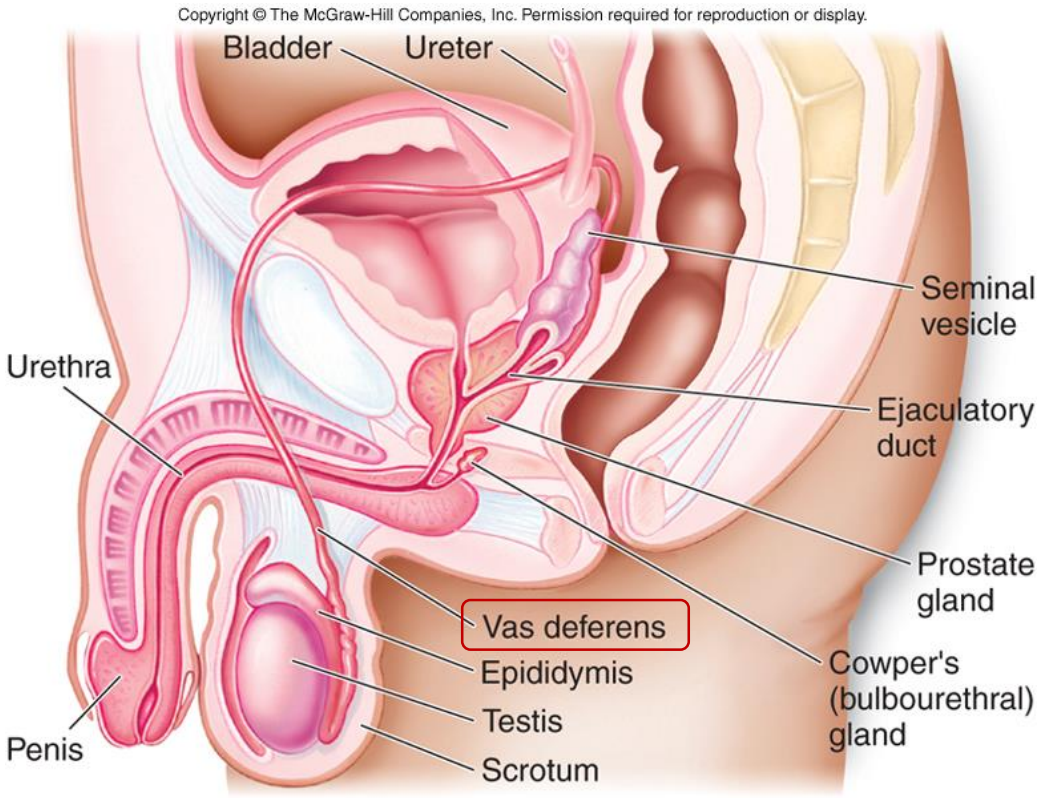

Hormonal Factors That Stimulate Spermatogenesis
Testosterone
By leydig cells (which located in the interstitial of the testis) essential for the division of the testicular germinal cells
Luteinizing hormone (LH)
By APG, which will stimulate leydig cells
Follicle stimulating hormone (FSH)
By APG, which will stimulate sertoli cells and stimulate the conversion of spermatids to sperm
Estrogen
Formed from testosterone by sertoli cells → under FSH
Growth hormone
Controlling metabolic function of the testis , also promotes early division of spermatogenesis so if there defect in GH it will cause infertility

Storage of the sperm

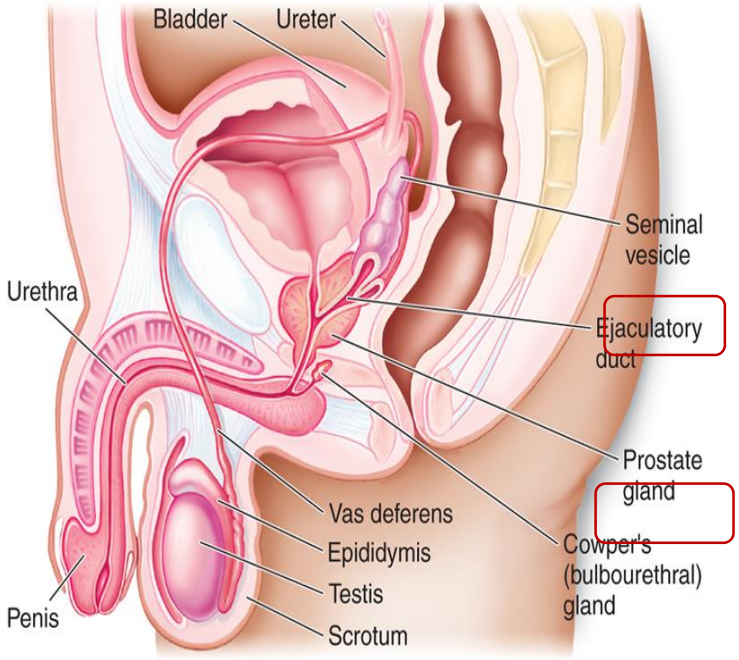
- The 2 testis of the adult human formed up 120 million sperm per day.
- Small amount stored in the epididymis.
- The majority stored in the vas deference, maintaining their fertility for at least a month.
- The sperm are inactive state by multiple inhibitory substance in the secretion of the ducts.

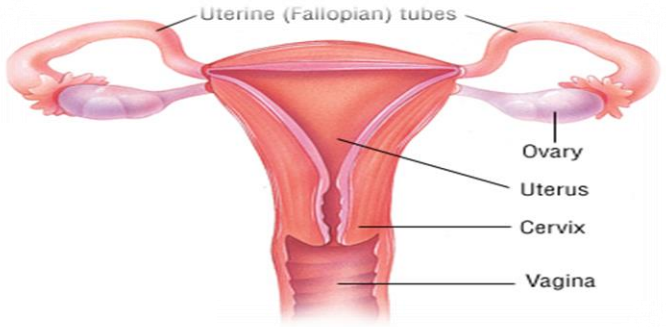
After ejaculation

- The sperm become motile & capable of fertilizing the ovum called maturation. (the sperm become mature in female genital tract).
- The sertoli cells and epithelium of the epididymis secrete nutrient fluid which contains (testosterone & estrogen).



The Seminal Vesicles & Prostate Gland





Function of Seminal Vesicles

Secrete **mucoid material** containing fructose, citric acid & nutrient substance & large quantities of **prostaglandins** & **fibrinogen**

Function of Prostaglandins

- By reacting with the female cervical mucus making it more receptive (يستقبل) to sperm movement
- By causing **backward reverse peristaltic contraction** of the uterus & fallopian tubes to move the ejaculated sperm toward the ovaries

Function of Prostate Gland

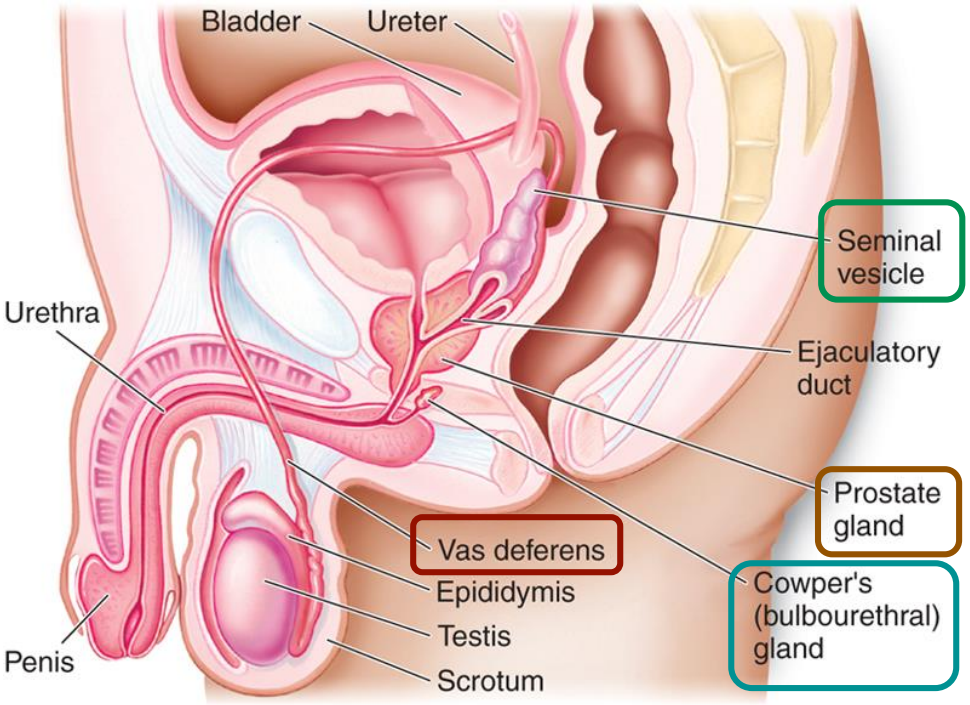
Secrete **thin milky fluid** contain Ca^{++} ion, citrate ion, phosphate ion, clotting enzyme & profibrinolysin.

Function of Alkaline Prostatic Fluid

- Successful fertilization of the ovum
- Help to **neutralize the slightly acidic fluid of the vas deference** (due to the presence citric acid and metabolic product of the sperm that inhibit sperm fertility)
- Help to **neutralize the acidity of the other seminal fluids** during ejaculation & enhances motility & fertility of sperm

Semen

ejaculated semen composed of the fluid & sperm



From vas deference (10%)

From the prostate gland (30%)

From seminal vesicles (60%)

Small amount from the mucosa gland (bulbourethral glands)

The average pH 7.5 (alkaline prostatic fluid neutralize the pH)

Fluid from the seminal vesicles & mucous glands give the semen mucoid consistency

Fertility

Sperm count

- The quantity of ejaculated semen about 3.5 ml.
- Each millimeter contain 120 million sperm (normal range is 35-200 million sperm)
- Sperm count below 20 million leads to infertility.

Sperm morphology & motility

- **Abnormal shape :-**
  - Sometimes sperm count is normal but still infertile when about 1 ½ of the sperm have abnormal shape.
- **Abnormal motility :-**
  - The shape could be normal and the count is normal but they either relatively non-motile or entirely non-motile → infertility

Capacitation Of The Spermatozoa

- Sperm in the epididymis is kept inactive by multiple inhibitory factors secreted by genital duct epithelium.
- They will be activated in female genital tract, for the processes of fertilization. These activation are called capacitation of the spermatozoa (1-10 hours).

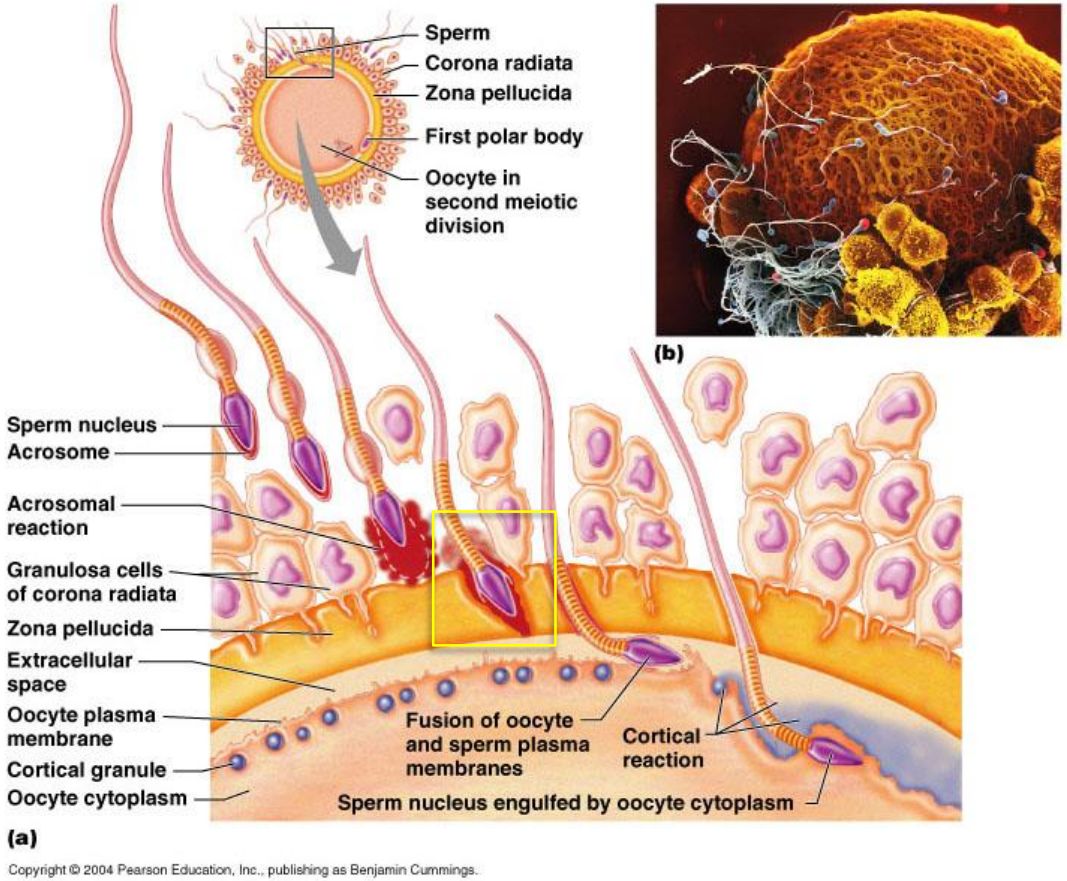
Uterine & fallopian fluids wash away the inhibitory factors which suppress the sperm activity in the male genital ducts (ينظف)

Cellular membrane covering the acrosome which is it covered by cholesterol which prevent the release of its enzyme.

After ejaculation the sperm removed from the cholesterol vesicle & this makes the membrane of the sperm head become weaker. Which will make it release of proteolytic enzyme

The sperm membrane becomes more permeable to Ca^{++} ion which increase their movement & help to release the proteolytic enzyme from acrosome which aid in penetration the ovum.

Acrosome Reaction



The acrosome cover the anterior 2/3 of the head of the sperm.

The acrosome store large quantity of hyaluronidase & proteolytic enzyme.

Hyaluronidase depolarizes hyaluronic acid polymers In the intracellular cement that hold the ovarian (me too).

Also the proteolytic enzyme digest the proteins.

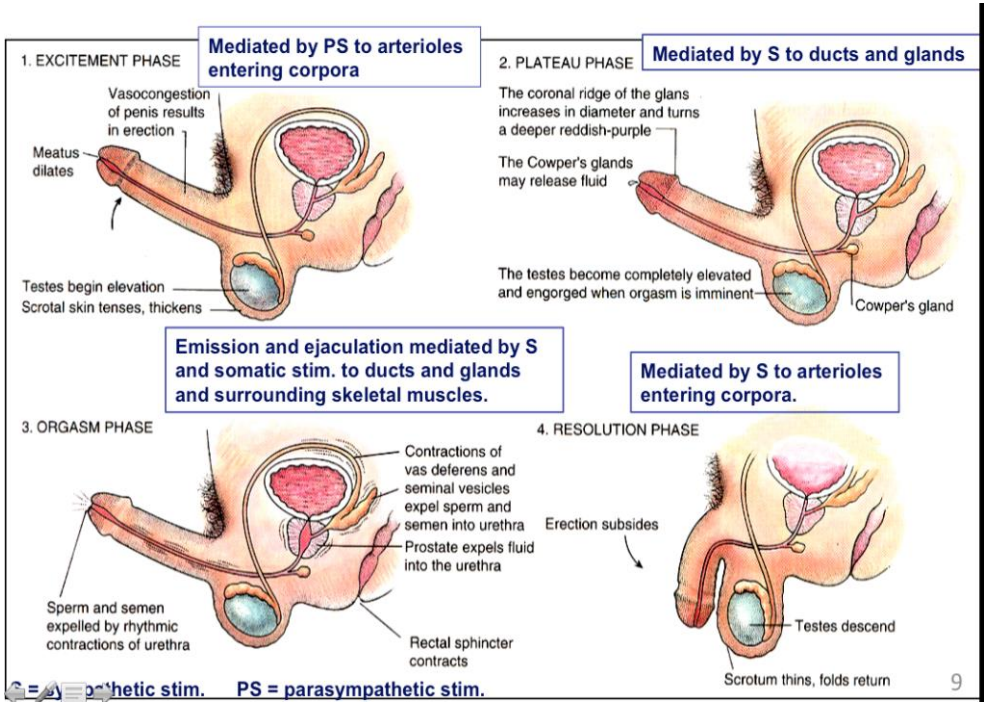
Male sexual act

➢ Stages of male sexual act:

1 **Penile erection:**
Erection is caused by parasympathetic impulses that pass from the sacral portion of the spinal cord through the pelvic nerves to the penis.

2 **Lubrication**:
Parasympathetic impulses cause the urethral glands &bulbourethral glands to secrete **mucous**.

3 **Emission and ejaculation:**
Function of the sympathetic nerves.



Emission begins by **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 fluids 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)**

Testosterone and other male sex hormones:

- Secretion of testosterone by the interstitial cell of leydig in the testis.
- The testis secrete several male sex hormone called androgens including **testosterone**, **Dihydrotestosterone** and **androstenedione**.
- **"Testosterone is the most abundant form"** while "**Dihydrotestosterone is most active" .**
- testosterone converted into Dihydrotestosterone in the target cells.

➢ Secretion & chemistry of androgens in the body:

- From **the testes** and **adrenal glands**.
- It is **synthesized** either from **cholesterol** or **directly from acetyl coenzyme A.**

➢ Metabolism of testosterone:

Testosterone bound with **beta globulin** and circulate in the blood for 30 minutes to several hours .

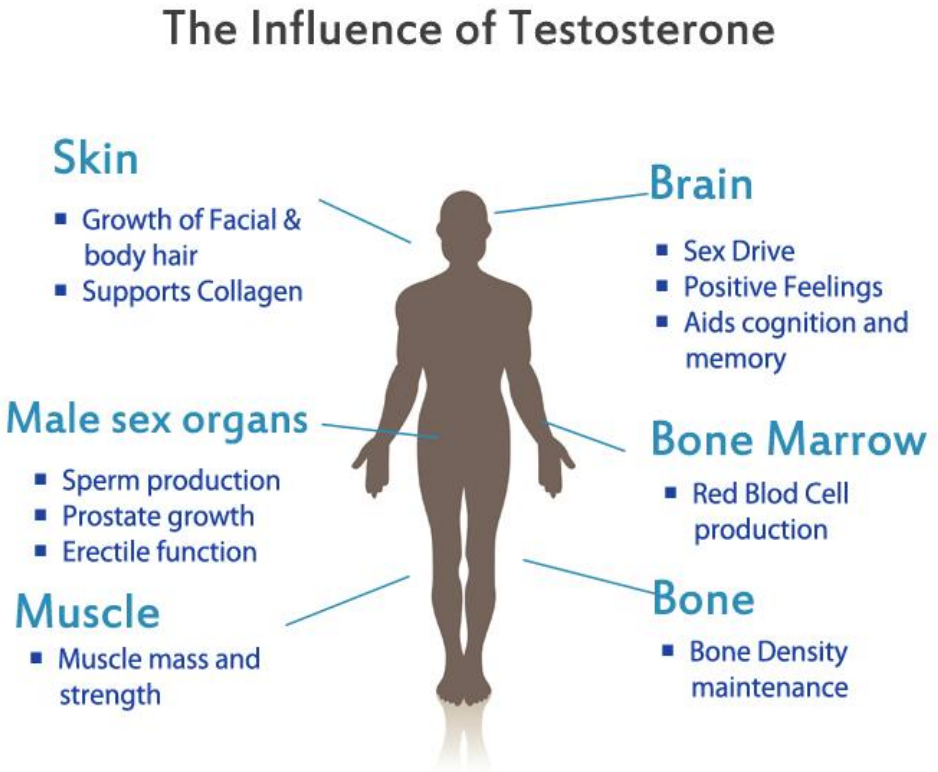
→ Converted to **estrogen** in the liver.

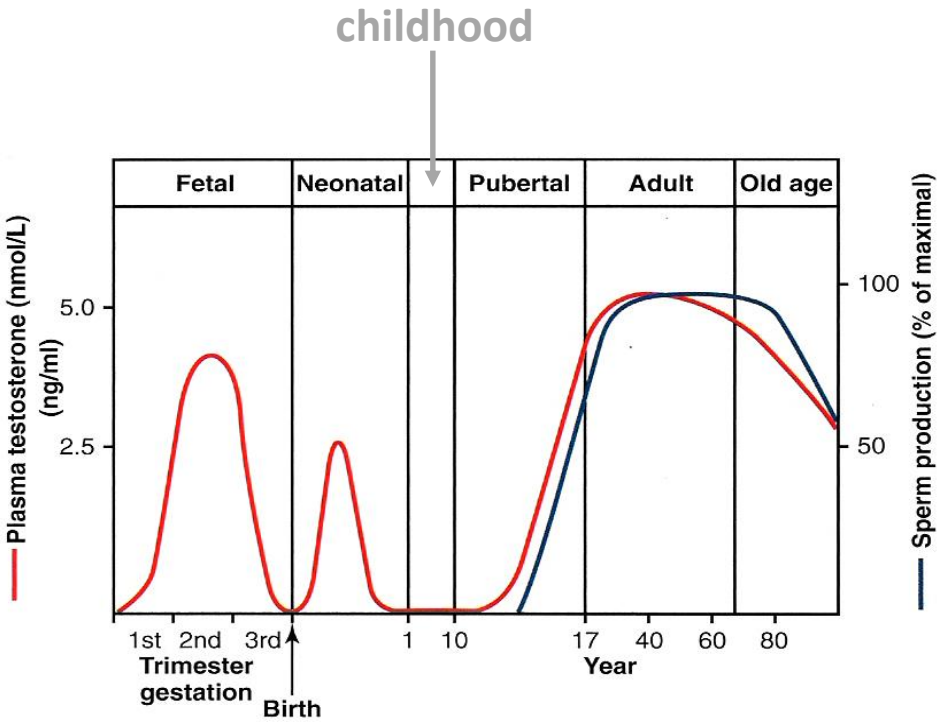
→ Excreted either into the **gut through liver bile** or into **the urine through the kidneys**.

➢ Functions of testosterone:

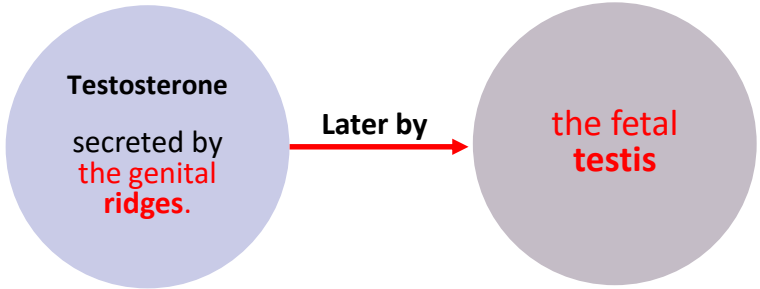
- It is responsible for the characteristic **masculine body**.
- **During fetal life** the testis are stimulated by placenta chorionic gonadotropin to produce testosterone throughout fetal life & the 10 weeks after birth
- **During childhood** there is no more testosterone production
- **At puberty** under the anterior pituitary gonadotropic hormones stimulation and **throughout life**.
- Beyond 80 years it decline to 50%.

Cont.


The Influence of Testosterone
Skin
Growth of Facial & body hair
Supports Collagen
Brain
Sex Drive
Positive Feelings
Aids cognition and memory
Male sex organs
Sperm production
Prostate growth
Erectile function
Bone Marrow
Red Blod Cell production
Muscle
Muscle mass and strength
Bone
Bone Density maintenance


childhood
Fetal
Neonatal
Pubertal
Adult
Old age
Plasma testosterone (nmol/L)
(ng/ml)
5.0
2.5
100
50
Sperm production (% of maximal)
1st 2nd 3rd
Trimester
gestation
Birth
1 10
17 40 60 80
Year

Function of testosterone during fetal development:



- **It is responsible for development of the male body characteristics including the formation of:**
  - Penis & scrotum.
  - Prostate gland, seminal vesicles
  - Male genital ducts .
  - Suppressing the formation of female genital organs.

➢ Effect of testosterone to cause descent of the testis:

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

➢ Effect pf testosterone on development of adult primary and secondary sexual characteristics:

After puberty

enlargement of:
- the penis
- scrotum & testis
- secondary sexual characteristics.

body hair

causes growth of hair:
- Over the pubis
- On the face
- On the chest
- Less often on other regions such as the back

Baldness

Testosterone decreases the growth of hair on the top of the head.

Two factors causes baldness:
1) Genetic background
2) Large quantities of androgenic hormones.

voice

It causes:
- hypertrophy of the laryngeal mucosa
- enlargement of the larynx

skin

- Testosterone increases the thickness of skin over the body & subcutaneous tissues.
- It also increases the secretion of the sebaceous glands & sebaceous glands of the face causing acne

Protein & muscle

Testosterone have anabolic effect by:
- Increasing muscular development after puberty by 50% in muscle mass over that in female.
- Increasing protein content in non-muscle parts of the body.

Cont.

➢ Effect pf testosterone on development of adult primary and secondary sexual characteristics:

Testosterone increases bone matrix and causes Ca2+ retention:

- Bones grow thicker
- deposit additional Ca2+thus it increases the total quantity of bone matrix
- causes Ca2+ retention (anabolic effect).
- it causes the epiphyses of the long bones to unite with the shafts of the bones & early closure of the epiphyses.

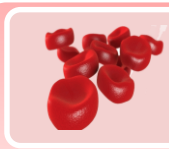
Testosterone has specific effect on the pelvis:

1) Narrow the pelvic outlet.
2) Lengthen it.
3) Cause the funnel-like shape instead of the broad ovoid shape of the female pelvis.

BMR

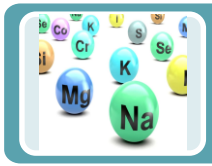
Testosterone increases basal metabolism:

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



Effect on red blood cells:

- It increases red blood cells/ml (due to increase metabolic rate).

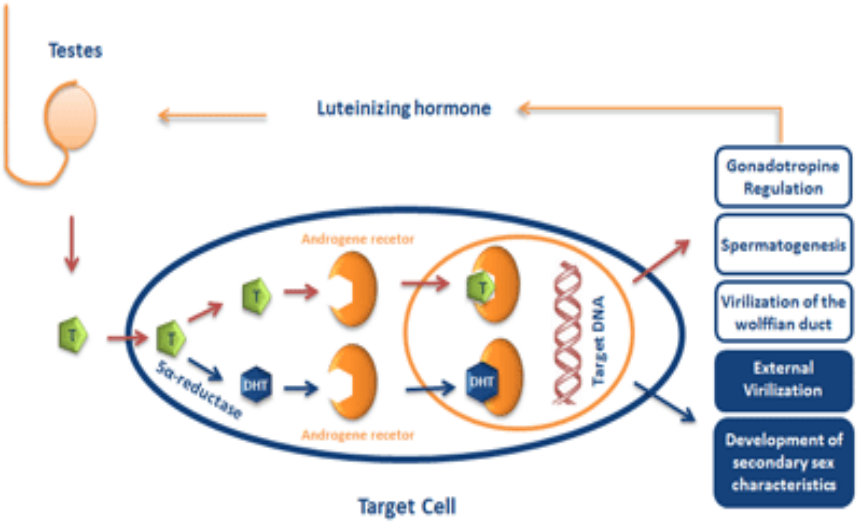


Effect on electrolyte and water balance:

- It increase the reabsorption of Na+ in the distal tubules of the kidneys.

➢ The basic intracellular mechanism of action of testosterone:

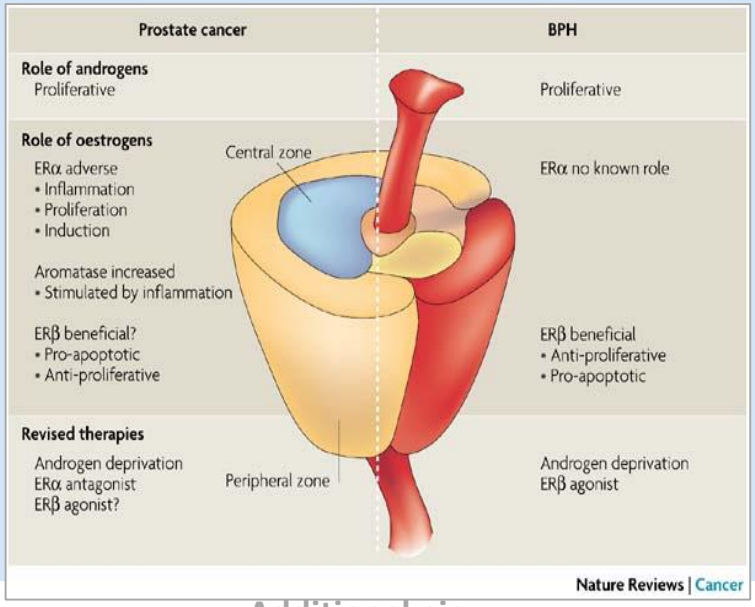
- It increases the rate of protein synthesis in target cells.
- Testosterone converted by the intracellular enzyme **5 α reductase** to Dihydrotestosterone, then it binds with **cytoplasmic "receptor protein".** Steroid hormone
- This combination moves to the nucleus where it binds **a nuclear protein** and induces protein formation.



Abnormalities of male sexual function:

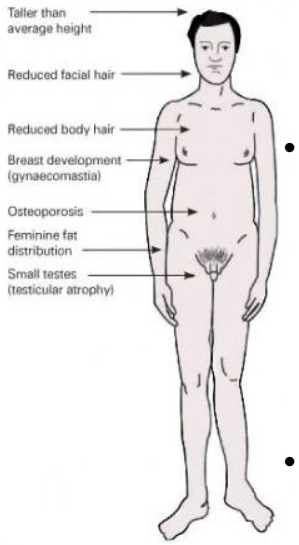
➢ Prostate gland and its abnormalities

- **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**.



Additional pic.

➢ Hypogonadism in male:



- During fetal life **when the testis are non-functional**, none of the male sexual characteristics develop in the fetus. Instead female organs are formed.
- If the boy loses his testis **before puberty,** a state **eunuchism*** (he have infantile sex organs & infantile sexual characteristics) & the height of an adult eunuch is slightly greater than normal because of slow union of the epiphyses.
- If a man is castrated **after puberty**, sexual organ regress in size and voice regress - loss of the thick masculine bones- loss of masculine hair production -loss of musculature of the virile male.

- **Adiposogenitial syndrome**, **Frohlich's 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 result in **obesity** with **eunuchism**.

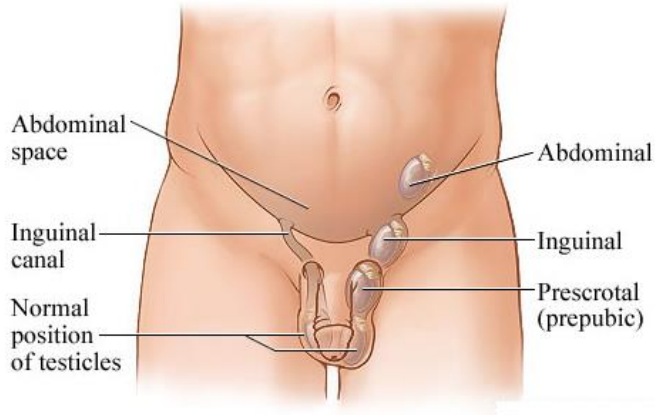
* A condition resulting from complete lack of male hormones. It may be due to atrophy or removal of the testicles.

Cont.

➢ Cryptorchidism

❖ **Failure of the testes to descend in the scrotum which normally occur during fetal life.**

- 10% of newborn males and it falls to 2% at age 1 year
- 0.3% after puberty
- They should be treated before puberty because of higher incidence of **malignant** tumors.



➢ Testicular tumors and hypergonadism in male:

- **Interstitial leydig cell tumors (rare),** over production of testosterone.
  - In children, causes rapid growth of the musculature and bones and early union of the epiphyses and causes excessive development of male sexual organs.

- **Tumor of the germinal epithelium (more common).**

Table 17–1 Summary of Testicular Tumors

Tumor	Peak Patient Age (yr)	Morphology	Tumor Marker(s)
Seminoma	40–50	Sheets of uniform polygonal cells with cleared cytoplasm; lymphocytes in the stroma	10% of patients have elevated hCG
Embryonal carcinoma	20–30	Poorly differentiated, pleomorphic cells in cords, sheets, or papillary formation; most contain some yolk sac and choriocarcinoma cells	Negative (pure embryonal carcinoma)
Yolk sac tumor	3	Poorly differentiated endothelium-like, cuboidal, or columnar cells	90% of patients have elevated AFP
Choriocarcinoma	20–30	Cytotrophoblast and syncytiotrophoblast without villus formation	100% of patients have elevated hCG
Teratoma	All ages	Tissues from all three germ cell layers with varying degrees of differentiation	Negative (pure teratoma)
Mixed tumor	15–30	Variable, depending on mixture; commonly teratoma and embryonal carcinoma	90% of patients have elevated hCG and AFP

AFP, alpha fetoprotein; hCG, human chorionic gonadotropin.

Additional pic.

MCQs

1- **When spermatogenesis starts ?**

A. 13 years old
B. Through all life
C. Infant life
D. Old age

2- **Which of the following parts could have non-motile sperms ?**

A. Vas deferens
B. epididymis
C. Penile urethra
D. Ejaculatory duct

3- **Where the majority of sperms stored ?**

A. epididymis
B. Vas deferens
C. Seminal vesicles
D. Ejaculatory duct

4- **Which period of life has no testosterone production ?**

A. Infant life
B. Adult life
C. Old age
D. childhood

5- **At fetal life testosterone production starts from?**

A. fetal testis
B. prostate
C. genital ridges
D. Allantois

6- **Which of the following is true about testosterone?**

A. Increases bone matrix
B. Decrease RBCs
C. Ca+ catabolic effect
D. Excrete Na+

Answers: 1(A)- 2(B)- 3(B)- 4(D)- 5(C)- 6(A)

SAQs

Q1:talk briefly about spermatogenesis

Ans: Sprematogonia modified and enlarged to form 1ry spermatocytes, each one undergoes meiotic division to form 2rd spermatocytes, then it will divided to form spermatids and after that become sperms.

Q2: mention 4 hormonal factors which stimulate spermatogenesis

Ans: LH, FSH, Testosterone and GH.

Q3: mention three reason for infertility

Ans: sperm count <20 million, abnormal shape, absent of motility

Q4: mention two function of testosterone during fetal development

Ans: cause descent of testis and suppressing the formation of female genital organs.

Q5: mention two effect of testosterone development of adult primary and secondary sexual characteristics

Ans: effect of the voice, baldness

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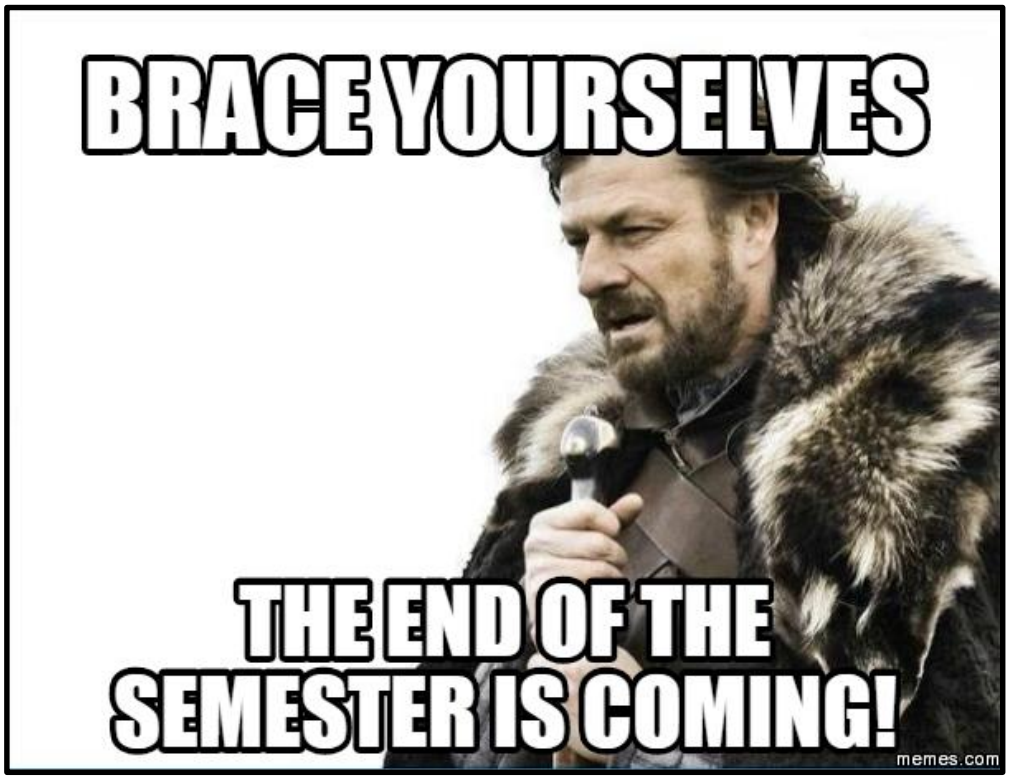

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Best Wishes..