



# Urogenital System

Sheet 1

Subject | Male reproductive system

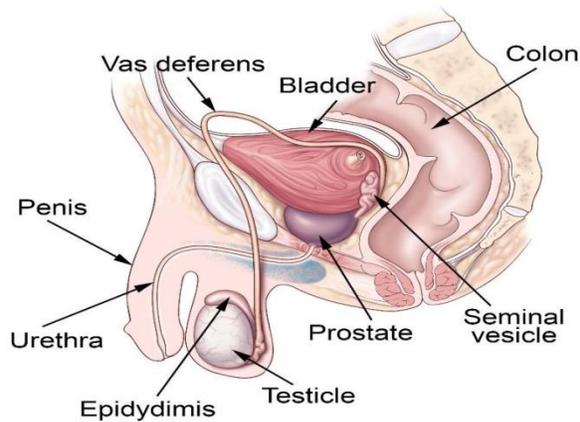
Done by | نداء بني عطا

Correction | Rawan almujaibel

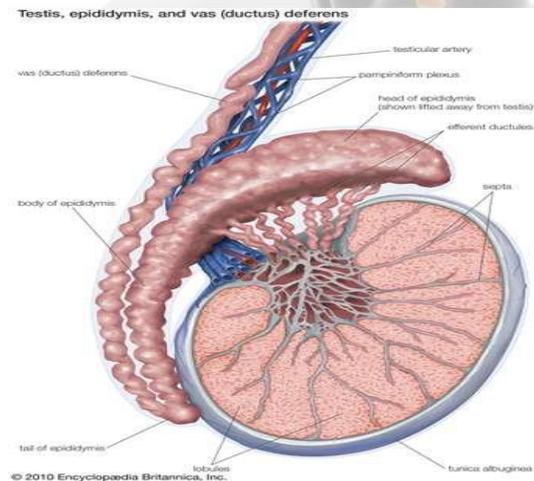
Doctor | د.إباء الزيدانة



## Male reproductive system:



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The system is composed of :

### 1- Testis:

It is the gonad of the male reproductive system where the sperms are produced there through a process called spermatogenesis. It is composed of 900 coiled tubules called seminiferous tubules ,each of them is about 0.5 m.

There is another coiled system called epididymis where the content of seminiferous tubule is transformed to it .epididymis is also a tubular system that is 6m in length .then content of epididymis is emptied into another organ which is vas deference.

### 2- vas deference:

it connects testis and epididymis with external and internal parts of reproductive system .vas deference continue and will enlarge (this enlargment called ampulla )so its content will be transported into ampulla then the content is emptied into ejaculatory duct.

### 3- Ejaculatory duct:

Two seminal vesicles which empty their secretion into ejaculatory duct before it's entering to the prostate glands . Then, prostate glands will also empty its secretion to ejaculatory duct .

### 4- Internal urethra:

It's between the ejaculatory duct and external urethra, There are some glands that have secretions such as bulbourethral glands into internal urethra, which passes the content of these organs to exterior.

## Spermatogenesis

This is a cross section of seminiferous tubule where sperms are formed by spermatogenesis.

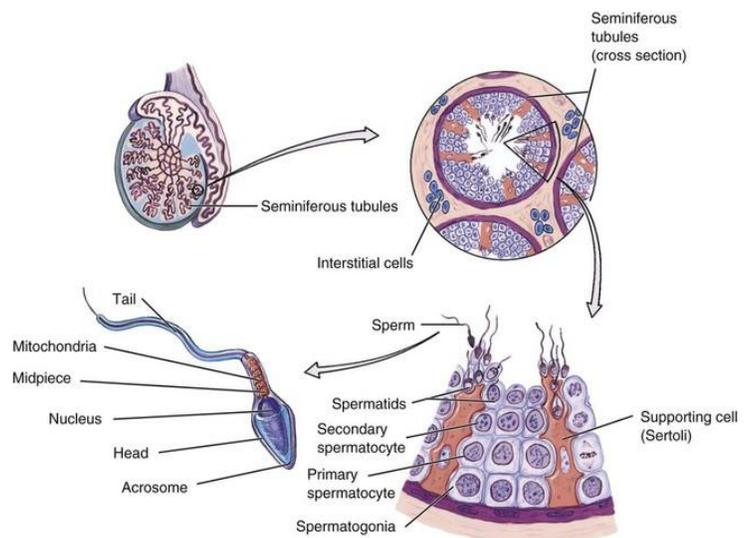
Spermatogenesis is the main function of male reproductive system .

We mean by spermatogenesis to produce sperms (male gametes ) that will fertilize female gametes (ovum) in order to produce fertilized ovum that will produce offspring .

Formation of sperm cells from immature cells (spermatogonia).

Spermatogonia as you see in cross section lie at inner lining of seminiferous tubule ;actually they originate from primordial germ cells that migrate into seminifrous tubule during fifth week of gestation. The production of sperms begins at puberty and may decrease in older age which is called Climacteric. However, spermatogonia cells are present at birth.

There are many cells supporting this process :



- 1- sertoli cells :large cells with envelops of cytoplasm –they surround developing spermatogonia –during converting to sperms around central lumen of siminefrous tubule. these cells actually start working under the influence of FSH from anterior pituitary (for nourishment and support) .
- 2- lydig cells :these cells are in the interstitium between seminiferous tubules .those cells are actually stimulated by LH from anterior pituitary gland .they function to secrete testosterone .they are numerous in newborn male infant only for first few monthes of life ,after that they will diappear until age of puberty .here gonadotropin hormone is stimulated along with testosterone start to be released under the influence of LH then lydig cells will be seen again. It is activated at puberty throughout adult life to secrete testosterone .

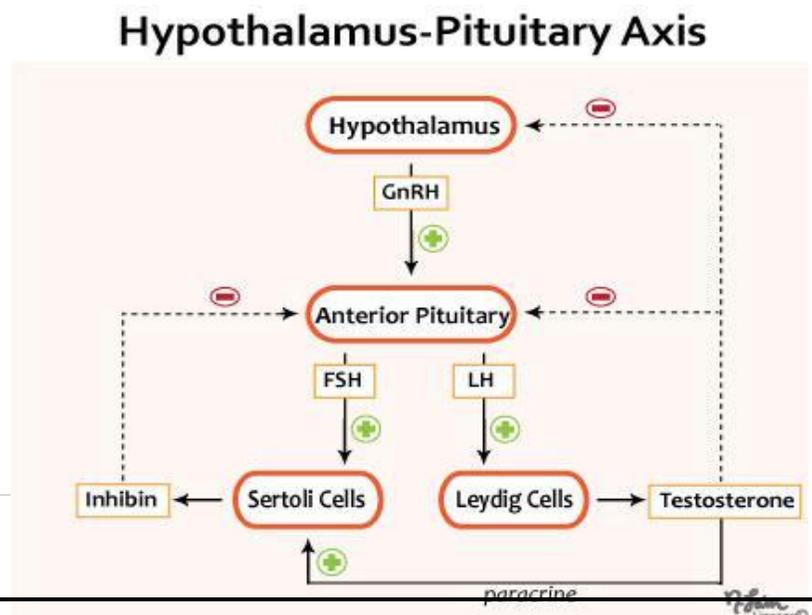
### Some normal factors that stimulate spermatogenesis:

- 1- testosterone: released by lydig cells in interstitium for growth and division of the testicular germinal cells.
- 2- LH: it has receptors at lydig cells ,once those cells stimulated start to secret testosterone .
- 3- FSH: is secreted under the effect of gonadotropin releasing hormone.FSH stimulate setoli cells and without this stimulation there is no spermatogenesis .
- 4- Estrogen: it has been proved as it secreted by sertoli cells when they are stimulated by FSH –this essential for spermatogenesis process
- 5- Growth hormones: metabolic function in testes and promotes early division of the spermatogonia themselves. if there is deficiency or no secretion of growth hormone there will be malformation with spermatogenesis and pituatry dwarfs.

### Hypothalamic anterior pituitary –gonad's axis :

This is a schematic representation of regulation of gonads function and different cell types for supporting spermatogenesis ;GNRH is secreted by hypothalamus and has stimulatory effect on anterior pituitary gland to secrete both FSH and LH

-LH will stimulate lydig cells to produce testosterone



-FSH will stimulate sertoli cells to support and induce spermatogenesis .

-testosterone :

1-play role with FSH to induce spermatogenesis.

2-also it has another androgenic effects including :male reproductive growth organ ,primary and secondary charecteristics of males .

3-testosterone also has negative feedback on :anterior pituitary when there is increased testosterone secretion reflect negative effect on FSH ,LH .Also has negative feedback on GtRH.also there are also other inhibitory factors from sertoli cells ;when there is increase of induction of spermatogenesis –inhibin will be released from sertoli cells accordingly have negative feedback on anterior pituitary gland and its secretion of LH and FSH .

## PROCESS OF spermatogenesis :

As we said sperms originate from priordial germ cells. They migrate from abdomen to testis and they are known as spermatogonia ( they are immature cells) then they line seminifrous tubule. From birth till the puberty, there is no chance to proliferate, however during puberty (13 year old ) GtRH will be stimulated and increased, so the spermatogonia will start mitosis (this stage takes around 25 days till give rise to primary spermatocytes –diploid ,46 chromosomes-. Then, these primary spermatocytes enter miotic division 1 –first stage – give rise to secondary spermatocytes –which are also diploid genetic matrial ,46 chromosome – after 9 days. Secondary spermatocytes enter miotic division 2 and after 19 days give rise to spermatids –haploid genetic material ,23 chromosome-. So the last step is that the spermatids differentiate within 21 days into mature sperms.

Notice that one primary spermatocyte will give rise 4 mature sperms –two of them have X chromosome and other two have Y chromosome ). The whole process takes around 74 days .

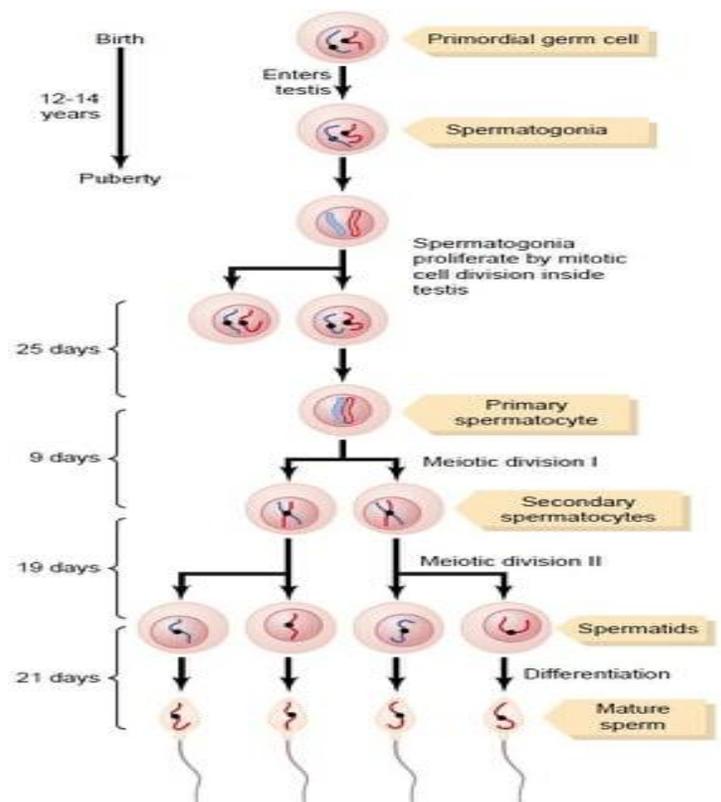


Figure 80-3

Cell divisions during spermatogenesis. During embryonic development the primordial germ cells migrate to the testis where they become spermatogonia. At puberty (usually 12 to 14 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.

### **characteristics of mature sperm :**

-Composed of head and tail (flagellum )

-Capable of movement (motile )

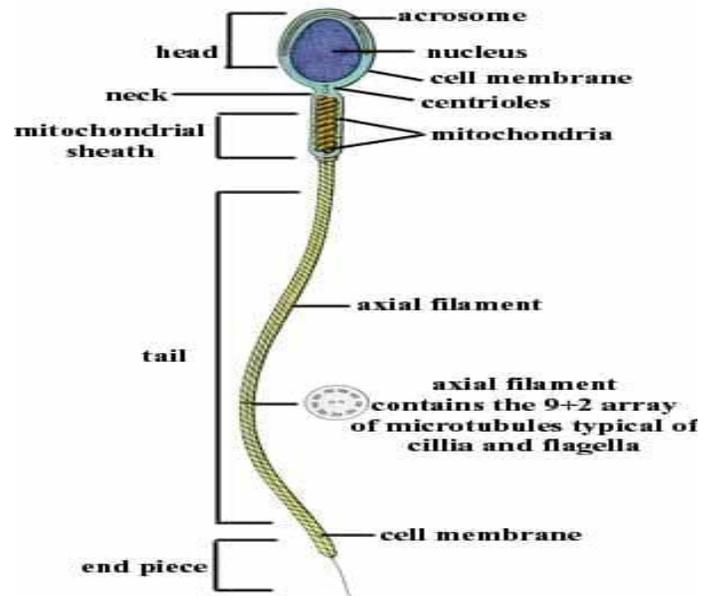
-Capable to fertilize ovum .

-They need to be in a neutral or slightly alkaline medium because highly acidic medium can cause death of sperms or shorten their life span .

-Sperms that ejaculated from male reproductive organ can live in female genital tract for 2 days .

- The head of sperm contain a structure called acrosome which is like acap of head of sperm ,and contain large quantaties of two enzymes : 1- hyaluronidase to digest proteoglycans 2-proteolytic enzymes to digest proiens. Both of these enzymes are important to digest cells surrounding ovum to fascilitate fertilization process .

-The tail of the sperm contain neck and body structures that contain mitochondria as well as microtubules – that help sliding movement of back and forth movement of flagellum in tail of sperm ,that overly fascilitate sperm motility -.



### **Maturation of sperms in epididymis :**

After formation of sperm in seminiferous tubule ,they have to pass through epididymis and at this point they aren't capable of motility .but within about 2 days they acquire modification –develop capability of motility in epididymis but still it isn't motile till this point despite having the capability because epididymal fluid has inhibitory proteins that prevent its motility along the duration when they are in epididymis ,but once it is ejaculated , the inhibitory proteins washed away and removed so now the sperms restore its motility after ejaculation ;so now it is capable of fertilizing ovum in female genetalia. At this point the sperms surely complete the maturation process .

-sertoli cells and epithelium of epididymis secrete nutrient fluid (testosterone ,estrogen), enzymes , nutrients essential for maturation .

### **Storage of sperms:**

The 2 testes of adult human form up to 120 million sperms each day. Small amount of these sperms are stored in the epididymis and the rest of sperms are stored in vas deferens and kept there up to one month (the life expectancy of the mature sperms only one month).

## Secretion of male glands:

There are other fluids secreted by different male glands ; which are :seminal vesicles ,prostate gland ,and bulbourethral glands .

- seminal vesicles secretion :

it compromise about 70% of total volume of semin ,and is composed of mucoid material which give the viscosity of the semin containing fructose, citric acid (give it acidic medium), and nutrient substances and large quantities of fibrinogen ( it is important for coagulation and aids in movement of sperms and semin in female genitalia) and prostaglandins which helps in fertilization by three ways :

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

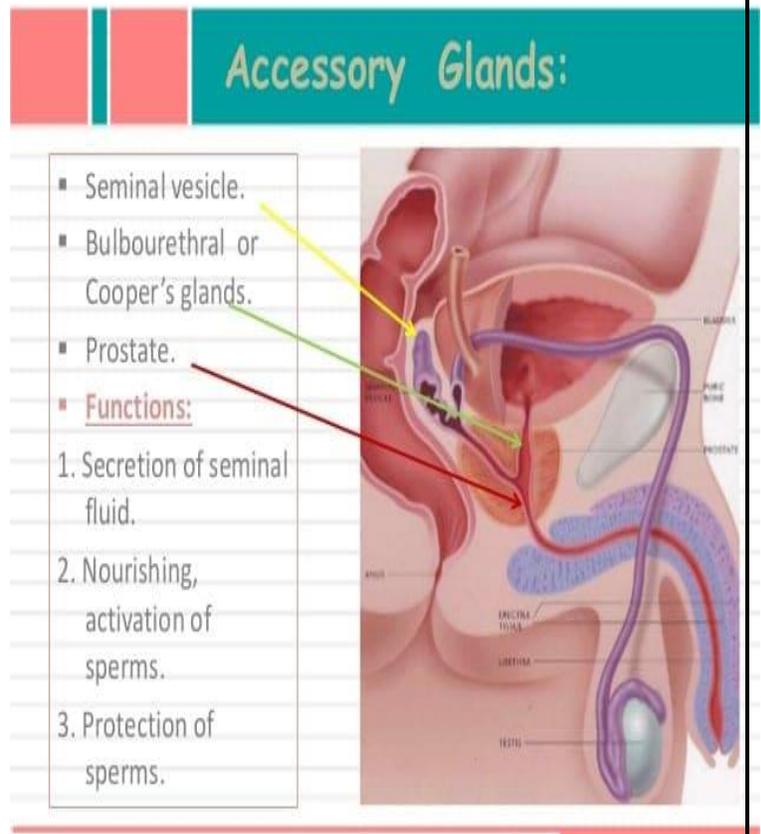
2-facilitate peristaltic contractions of uterus and fallopian tubes which also enhance movement of sperm toward ovaries .this eventually is very important for fertilization to occur .

3-it has been suggest to reduce immune response in female reproductive system toward foreign sperms.

- Prostate gland secretion:

has a characterization to be thin ,milky and alkaline ;they contain  $Ca^{+2}$  ,citrate ion as well as phosphate ions ,clotting enzymes and profibrinogen lysis enzyme -. Alkaline prostat fluid is important for successful fertilization of ovum:

- 1- it neutralize acidic fluid in vas deference because acidic media depress sperms and decrease their life expectancy accordingly can inhibit fertility.
- 2- neutralize acidic vaginal secretions in female reproductive system which also bad environment of sperm motility .so this alkaline secretion is important to maintain viability of sperms .



**semin** that is ejaculated is composed of :

- 1- sperms that come from testis and epididymis through vas deference which is only 10% of total volume .
- 2- majority are come from seminal vesicles .. around 60%-70%
- 3- 30% come from prostate gland alkaline secretion .
- 4- Very small amounts from mucus secretion in bulbourethral glands –that lubricate and fascilitate movement of secreted fluid .

### **capacitation of spermatozoa:**

In female genital tract ,freshly ejaculated semen undergoes capacitation which take place within 1-10 hours ;this happens after being ejected by 3 processes :

- 1- washing out inhibitory factors –that inhibit motility of sperms –by uterine and fallopian fluids .
- 2-sperm swim away from cholesterol vesicles –they get out of acrosome at head of sperm –so acrosome becomes thinner .
- 3- memebrane of sperm become more permeable to  $ca^{2+}$  ions which is necessary for fertilization of ovum process .

### **Main sex hormones in male genital system:**

Testis secretes several sex hormones called (androgens )including :testosterone ,dihydrotestosterone ,androstendione .

-Androgens :are steroid hormones related to musculinzing effects which responsible give males secondary physical chareteristics

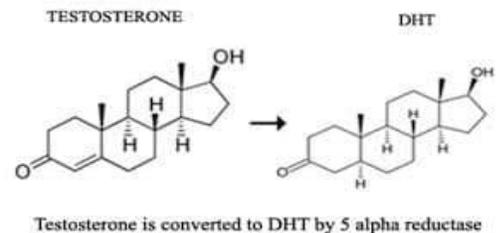
-Testosterone: is the main one among androgens and is the most abundant .

-Dihydrotestosterone: is the least abundant and the most potent one .

(Most of testosterone hormone is converted to dihydrotestosterone in target cells).

-Testosterone is secreted by testis and androgens are secreted from both testis and adrenal glands .

-Origin /source of androgens is from cholesterol or directly from acetyl coA.



### **Intracellular mechanism of action of testosterone :**

as we know, testosterone is a steroid hormone so it is capable of entering /diffusing into target cells then it will converted by 5-alpha-reductase into dihydrotestosterone.

DHT compound to hydrocytosolic androgen receptors, then the complex will be translocated into dimers (hormone transport element) to induce gene expression that will end up with increase protein synthesis in target cells. (it is considered anabolic hormone).

## Other functions of testosterone:

testosterone isn't secreted only in adult life to induce spermatogenesis to produce sperms and give male characteristics but is secreted also in neonatal fetal life –as in middle trimester of gestation, there will be a peak (increase) in plasma level of testosterone induced primarily by human gonadotropic hormone that has similar effect of LH in secreting testosterone. 10 weeks after birth, testosterone level will be high without proceeding with sperm production; this is actually responsible for male reproductive organ growth.

The Main functions of testosterone during fetal development: testosterone that is secreted by genital bridges in the first 7 weeks of gestation, and testosterone secreted in the last

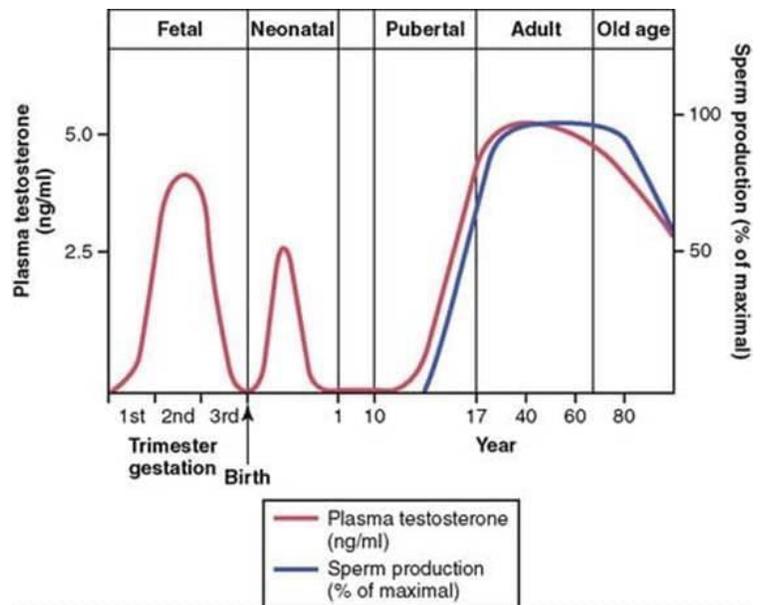
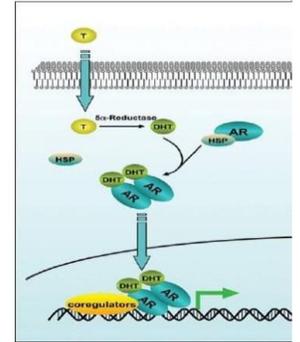
trimester is responsible for development of male body characteristics including formation of penis and scrotum. Also, it suppresses formation of female genital organs instead of male genital organs and increased secretion of testosterone is important for descending testis which occur in the last two or three months of gestation but if this process failed due to suppression of testosterone should be treated nonsurgically by injecting testosterone to help testis to descend into scrotum.

## The effect of testosterone on development of adult primary and secondary sexual characteristics:

- 1- After puberty: when testosterone starts to be released and increased its amounts will cause enlargement of male sex organs as well as the appearance of secondary sexual characteristics in male

### The basic intracellular mechanism of action of testosterone

*It increases the rate of protein synthesis in target cells.* Testosterone is converted by the intracellular enzyme 5 $\alpha$  reductase to dihydrotestosterone (DHT), then it binds to cytoplasmic "receptor protein". This combination moves into the nucleus and initiates gene transcription and induces new protein formation.



- 2- Effect on distribution of body hair :so it increases growth of hair over different areas of the body including face ,abdomen.
- 3- Increases the chance of having Baldness :in some people it increases chance of baldness if there is a genetic background –inherited baldness charecteristics –and if it compound to large quantities of androgen .
- 4- Effect on voice :it causes hypertrophy of mucosa in larynx then larynx enlargement will cause cracking of voice and give musclin voice characteristic of adult male .
- 5- Testosterone affects the thickness of skin and increases sepacious gland secretions which may contribute to acne development .
- 6- Testosterone has anabolic effect :it increases protein synthesis as well as muscle development which is a musclin characteristic of males .
- 7- Testosterone has activity on deposition of bone matrix and calcium retention of bone –this increases thickness and quality of bones due to anabolic effect of testosterone ,also it increases basal metabolic rate indirectly by about 15-20%.
- 8- Effect on RBCs :testosterone has positive effect on increase RBCs by 15-20% due to increasd metabolic rate .
- 9- Effect on electrolyte and water balance :as it increases reabsorption of Na+ in distal tubules .

## **The abnormalities of spermatogenesis and male sexual function:**

- The count and shape of sperm affect fertility ;

-The quantatity or volume that is ejaculated is about 3-5 ml and with every ml there will be average of 120 million sperm (normal average of sperm count )

- The effect of morphplogy and motility of the sperm have very important effect on fertility and in case of sperm count can be normal but the shape is abnormal which can lead to infertility , another case the shape is normal but relatively or entirely non motile that causes infertility as well .



Abnormal infertile sperm, compared with a normal sperm on the right.

- Prostate gland abnormalities ;

1-benign prostatic fibroadenoma :occurs in older age due to overgrowth and over proliferation of prostate tissue –this condition is independent and not caused by testosterone .

2-cancer of prostate gland :caused by stimulation of cancerous cells by increased testosterone production , so its dependent on testosterone .

- Hypogonadism in male ;can take place in different stages of male development

- during fetal life :happens because of nonfunctional testis therefore there is no male sexual charecteristics develop in fetus and instead there will be female organ development .

- if boy loses testis before puberty :this will cause a condition called (eunachism). eunachism represented by having infantile sex organs and developing infantile sexual charecteristics .

- if man is castrated (removed his testis ) after puberty ;then sexual organs regress in size and voice regress but main male secondary charecteristics will remain .

- Adiposogenital syndrome ;as Hypogonadism can be due to genetic inability of hypothalamus to secrete normal amount GnRH which can be resulting from hypothalamus from CNS ,this condition is accompanied with obesity as well as eunichusm .

- Cryptochidism :failure of testis to descend in the scrotum which takes place during fetal life .

- Testicular tumors and hypergonadism in male ;if happened during interstitial leydig cell tumor which is rare condition –there will be overproduction of testosterone in children –cause rapid growth of musculature and bone ,in addition excessive development of male sexual organs . but if it took place in adult it might be hard to recognize /see the effect of high testosterone secretion .

**NOTE:** at the end of this lecture the Dr. left a slide with self study material ( the stages of male sexual act) and some recommended reading (Guyton and hall book chapter 80). **The last slide summery is below.**

### **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**.

If you have any question please don't hesitate to contact me ....GOOD LUCK every one

من رجب العلم، رجاظت به فضائله