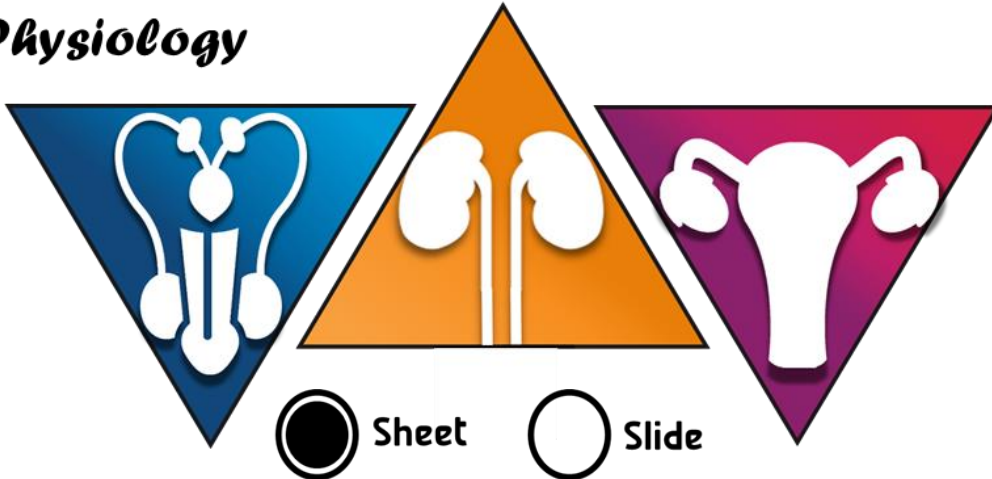




Urogenital system

Physiology



Number: - 2

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- During the fetal development , the testes are in the abdominal cavity and in the last three months of pregnancy they descend gradually to the scrotum under the effect of testosterone and insulin like hormone . However, sometimes they don't descend "Cryptorchidism".
- The most biologically active androgen even more active than testosterone is Dihydrotestosterone (DHT).
- Testes are in the scrotum because spermatogenesis requires a lower temperature than the body temperature to occur normally.
- Scrotum's temperature is lower that of the body by 2-3 degrees, spermatogenesis doesn't occur in temperature above 35 .

2 mechanisms maintain testes temperature :

A. The pampiniform venous plexus(countercurrent exchange) helps regulate the temperature of the testes by acting as a "heat exchange" mechanism to cool down the blood. The arteries supplying the testes run through the plexus where the blood is cooled from abdominal arterial temperature to testicular temperature. Arterial blood reaches the testes and cooler venous blood leaves through the pampiniform plexus.

B. The cremaster muscle lowers and raises the testes depending on the temperature.

Testosterone

There is no zero level of testosterone in the body . However , during childhood there are very low levels of testosterone and almost no difference in this

level between males and females. Thus there are no differences between girls and

boys in body mass, skeletal mass and the body fat due to the similarity in testosterone levels. After puberty , testosterone starts to rise , so differences between males and females start to appear, for example: males will have twice the number of muscles cells in females and 1.5 times the muscles mass of the female . at the end of puberty males have 150% of the lean body mass of the average female and women have 200% of the body fat of the men. In the testes, testosterone is produced by the Leydig cells and 5% by other tissues. Several tissues produce testosterone (as well as other androgens)other than testes these are:

- 1) Adipose tissue.
 - 2) Muscles.
 - 3) Brain.
 - 4) Skin.
 - 5) Adrenal cortex. .
- Testosterone is a pro-hormone found in the testes, pituitary and muscles.
 - In the liver, kidney, adipose tissue, CNS, skin and hair; testosterone is converted into estradiol as there is aromatase enzyme in such tissues.
 - In prostate, scrotum, penis and bone testosterone is converted into dihydrotestosterone by the action of 5 -alpha-reductase enzyme.

- metabolized in the liver and kidney to 17-ketosteroids by conjugated enzyme.
- Note: These substances are produced de-novo or by peripheral conversion of the precursors.
- In normal men, no correlation was found between circulating levels of testosterone and sexual drive, frequency of intercourse, or sexual practices as well as impotency and homosexuality. So, men only require normal level of testosterone as increased level has no effect on sexual activity.
- Functions of testosterone: -
- A- Functions of Testosterone During Fetal Development:
 - Intra-urine differentiation of male reproductive organs; high levels of testosterone due to placental HCG.
 - Seminal vesicles, epididymis and vas deference
 - Scrotum, penis and prostate (require dihydrotestosterone).
 - Descending of the testes from the abdomen to the scrotum.

B- Effect of Testosterone on Development of Adult Primary and Secondary Sexual Characteristics:

- Testosterone is important for sex drive and behavior.
- It also affects adipose tissue and cholesterol derivatives (LDL, VLDL and HDL).
- It increases muscle cells, RBCs.
- It is needed for spermatogenesis.
- It is also responsible for baldness.
- pubertal development ex. voice
- semen formation
- -abdominal visceral fat
- -muscles and skeleton
- -sperm production
- -growth of prostate and seminal vesical
- -feedback on gonadotropin secretion

Dihydrotestosterone

- DHT is 30 times more potent than testosterone.
- It is responsible for the differentiation of penis, scrotum, and mainly prostate
- The growth and secretory activity of sebaceous glands on the face, upper back, and chest are stimulated by androgens mainly dihydrotestosterone and inhibited by estrogen.
- increased sensitivity of these sebaceous glands to androgens is due to acne vulgaris bacteria especially during puberty in both males and females
- It is essential that testosterone gets converted to dihydrotestosterone, as low levels of dihydrotestosterone will cause osteoporosis. However high levels of dihydrotestosterone will cause prostate hyperplasia

- Clinical correlation “ GnRH and prostate hyperplasia”: prostate hyperplasia usually occurs due to high levels of dihydrotestosterone.
- Drugs that Inhibit enzyme 5 alpha-reductase will also decrease the level of dihydrotestosterone.
- castration is removing the testes by:-
- -chemical castration: Normally, GnRH is released in pulsatile manner from the hypothalamus , it stimulates the release of FSH and LH from anterior pituitary ,then these two hormones will stimulate the synthesis and release of testosterone and once testosterone level is increased, the production of its derivative “dihydrotestosterone” will also increase. But, If the GnRH was released continuously it will result in suppression of FSH and LH release thus testosterone and dihydrotestosterone levels will decrease. Based on that , continuous GnRH administration is used to treat prostate hyperplasia.
 **Continuous GnRH administration -> inhibits dihydrotestosterone synthesis
 ➔ reduction in prostate growth.
- -surgical: last resort is removing the testes
- Castration of a man will result in regression of reproductive tracts and involution of the accessory glands as well slow decline but not complete in sexual interest and a complete loss of sexual activity
- The most important derivative of testosterone is dihydrotestosterone; it is more biologically active than testosterone; which means that dihydrotestosterone is stronger than testosterone.
- NOTE: sometimes surgical castration is done to treat prostate enlargement when chemical castration fails.

Sperm

Sperms parts: head, neck and tail.

The head contains the nucleus which houses the chromosomes (22+X or 22+Y) and is covered by acrosomal cap which contains enzymes that lyse the tissues around the ovum , these enzymes are inactive .meaning acrosome doesn't release these enzymes unless the sperm is in vicinity of the ova only then the sperms release their enzymes, the sperm that is in contact with the ova releases other enzymes especially hyaluronidase to penetrate the ovum. note : a lot of sperms will release their enzymes , but only 1 will penetrate the one that releases hyaluronidase.

other enzymes include: -

Hyaluronidase (the most important)

Phospholipase A

Acrosin

Neuroamidases

Esterases

-middle piece: contains mitochondrial sheath for energy

-tail: for movement

Puberty

- Period when a boy or female becomes sexually mature.
- Puberty in females occurs at ages from 10-14 years old whereas in males it occurs at ages 12-16 .
- Causes physical changes and affects boys and girls differently, the first sign of puberty in girls is different than that in boys.
- Causes of delayed puberty (normal variant):
 - familial
 - racial
 - coincidental illness that increases body temp and severe chronic disease ex. TB, Typhus.
 - psychological stress
 - hypogonadism
 - hyperprolactemia

Note about prolactin, it binds to the LH receptors and it synergizes with LH in the production of testosterone (produce normal levels). In the case of hyperprolactemia, prolactin will occupy all the LH receptors, LH wont bind and consequently testosterone levels will drop .

Impotence and sterility

Impotency is sexual dysfunction characterized by the inability to develop or sustain an erection of the penis during sexual activity, Thus impotency

is erectile dysfunction. It is one of the causes of sterility –infertility.

- Sterility is the same as infertility ,inability of a man to get a woman pregnant (inability to reproduce) .
So, impotency leads to sterility, but sterility doesn't always mean impotency.
- Causes of impotence :
 - 1)Psychological disturbances -the most common cause e.g: from our society orphans
 - 2) Drugs like cocaine.
 - 3) Autonomic neuropathy like those caused by diabetes.
 - 4) Hyperprolactinaemia.
 - 5) Hypogonadism.
 - 6) Vascular/Heart disease and surgeries.

Physiology of erection

Stimulation of parasympathetic nerves→causes nitric oxide release from vascular

endothelial cells And it activates guanylyl cyclase enzyme→ which produces cGMP from GTP→resulting in calcium channels

closure→decrease in intracellular calcium→ vascular smooth muscle relaxation→As the vascular smooth muscles relax, blood flow into the penis increases, causing release of nitric oxide from the vascular endothelial cells and further vasodilation.
→ Then cGMP is converted into GMP by phosphodiesterase enzyme in order to terminate the relaxation.

Viagra (sildenafil)

- 1) It is a phosphodiesterase inhibitor used to treat impotence. It is the most common drug used in case of impotency.
- 2) Once phosphodiesterase inhibited → prevents degradation of cGMP to GMP→ prolong the effect of cGMP → prolonging the duration of smooth muscles relaxation and maintains erection.
Note: Viagra doesn't work in severe diabetes and heart disease
- 3) Viagra is used mainly by young people; around 40% of its users are younger than 35 years old (2015 sheet doctor said 70% but google says 40%)
- 4) Not all types of impotency are treated by Viagra
- 5) Viagra was first used to treat hypertension, but they noticed that it affects the penis, before Viagra they were using other chemicals, but Viagra became famous because it not aphrodisiac meaning it doesn't function immediately and cause erection unless the male is stimulated by the female
- 6) Now there is a Viagra for females
- 7) Side effects are similar to any drug, so patient with heart, kidney and liver disease has to be careful even those who take paracetamol. If the dose is high it will cause death even in healthy patient here it will cause hypotension and death but what about those with hypertension, they are already taking antihypertensive drugs those in addition to Viagra will cause death. So, dose should be kept below 100mg and doses above that aren't beneficial and might cause death
Viagra shouldn't be used daily, and shouldn't be taken with antihypertensive drugs especially ACE inhibitors
- 8) Viagra works against malaria
- 9) Viagra can help control blood sugar (diabetes)
- 10) Viagra used in heart failure and protect against the risk of heart diseases, brain stroke, fatty acids catabolism, prostate cancers

Semen

Composition: -

- 10% sperms
- 90% fluids, buffers, enzymes, cholesterol and vitamins from seminal vesicles and prostate
- Secretion of these accessory glands promote survival and fertility of sperms
- When the semen is ejaculated into the female immediately it coagulates to prevent the loss.

- The semen contains fructose which is essential for the nourishment of the sperms.
- Some of these enzymes in the semen were not intended to have their action on the sperm; rather they were intended to work on the ovum, such as proteolytic enzymes and hyaluronidase enzyme.
- To establish the causes of reproductive dysfunction , do physical examination , ask for medical history , perform semen analysis , hormone stimulation test, and genetic analysis.
- One step in the evaluation of fertility is by semen analysis, where semen is collected after 3-5 days of Sexual abstinence .

semen analysis steps:

Table 8.2 Seminal fluid — mean values for a fertile semen

Volume	3.5 ml (Range 1–7 ml)
Sperm count	100 million/ml (minimum 20 million/ml)
Motility	Normal in more than 60 per cent of total
Morphology	Normal in more than 60 per cent of total
Secondary liquefaction	Complete within fifteen minutes
Fructose content	2.2 g/l

Inflammatory cells and blood elements should be absent; spermatozoal precursor cells should not exceed 10 per cent of sperm count

* Oligospermia: Low sperm count (below 20 millions/ml).

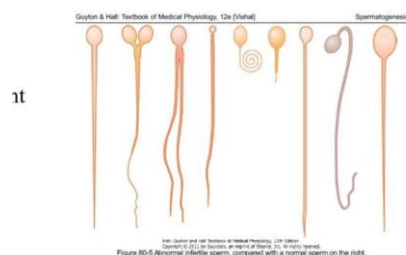
* Azospemia: No sperms at all.

1. Measure the volume of semen which is usually 3-4ml, but it can range from 1-7 ml (follow the table above).

2. Sperm count, usually 100million sperm/ml of semen ,ranging from 20million to 120 million per ml of semen in this case no problem in , below 20million fertility is affected, total sperm number 300million to 400million.

Oligospermia: low sperm count (below 20 million), Azospermia: no sperms at all. We give them LH or HCG.

3. sperm motility percentage ranges from 60-70% ,not all sperms are motile



4. Normal morphology should be found in more than 70% of the sperms (ranging from 65% to 75%).. (the pic above shows abnormal morphology of the sperms. The right one is normal and the others are

abnormal (two heads, two tails...).

5. Liquification , as said eariler , immediately after ejaculation semen coagulates but within minutes it liquifies again under the effect of enzymes if this is delayed more than 30 minutes fertility is affected

* The sperm should reach the fertilization site within 30-60

minutes after ejaculation.

- The number of sperms reaching the fertilization site is 0.001 of the total sperm after that infertility occurs, so why do we have 300mill -400mill ejaculated if only 0.001 will be ejaculated.
some sperms remain in the uterus some move in two directions and 60-70% are only motile .