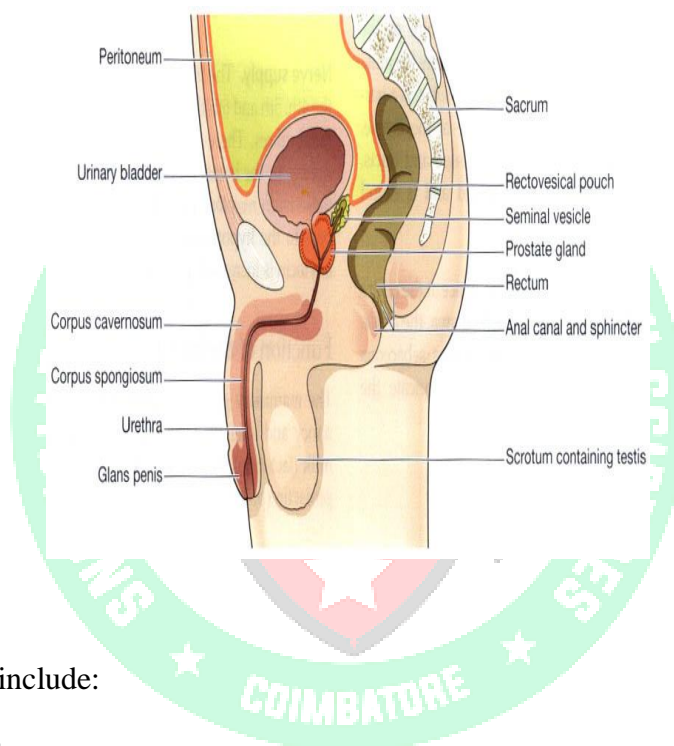




**UNIT-5 ANATOMY OF MALE REPRODUCTIVE SYSTEM, FUNCTIONS OF FEMALE
REPRODUCTIVE SYSTEM, SEX HORMONES**

Reproductive system ensures the continuation of species. Gonads are the primary reproductive organs which produce the gametes (egg or ovum); a pair of testes (singular = testis) produces sperms in males and a pair of ovaries produces ovum in females



Reproductive organs include:

1. Primary sex organs
2. Accessory sex organs.

Primary Sex Organs

Testes are the primary sex organs or gonads in males.

Accessory Sex Organs

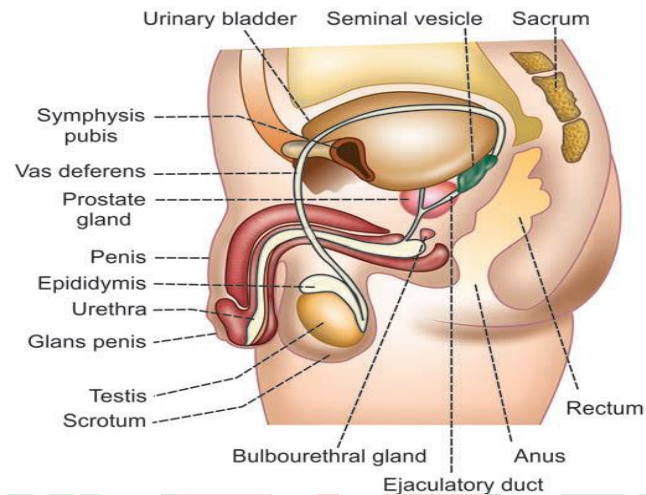
Accessory sex organs in males are:

1. Seminal vesicles
2. Prostate gland
3. Urethra

4. Penis.

Reproductive organs are generally classified into two groups, namely external genitalia (genital organs) and internal genitalia.

- External genitalia- scrotum, penis and urethra
- Internal genitalia- seminal vesicles, testes, vas deferens and ejaculatory duct



FUNCTIONAL ANATOMY OF TESTES:

- ✓ Testes are the primary sex organs or gonads in males.
- ✓ There are two testes in almost all the species.
- ✓ In human beings, both the testes are ovoid or walnut-shaped bodies that are located and suspended in a sac-like structure called scrotum.
- ✓ Each testis weighs about 15 to 19 g and measures about 5×3 cm.
- ✓ Testis is made up of about 900 coiled tubules known as seminiferous tubules, which produce sperms.
- ✓ Seminiferous tubules continue as the vas efferens, which form the epididymis.
- ✓ It is continued as vas deferens.
- ✓ Vas deferens is also called ductus deferens, spermatic deferens or sperm duct.
- ✓ From epididymis in scrotum, the vas deferens extends on its one side upwards into abdominal cavity via inguinal canal. Terminal portion of vas deferens is called ampulla.
- ✓ Ampulla of vas deferens joins ducts of seminal vesicle of same side, to form ejaculatory duct.

- ✓ Thus, there are two ejaculatory ducts each of which receives sperm from vas deferens and secretions of seminal vesicle on its own side.
- ✓ Both the ejaculatory ducts empty into a single urethra.

COVERINGS OF TESTIS:

Each testis is enclosed by three coverings.

1. Tunica Vasculosa

- Tunica vasculosa is the innermost covering.
- It is made up of connective tissue and it is rich in blood vessels.

2. Tunica Albuginea

- Tunica albuginea is the middle covering.
- It is a dense fibrous capsule

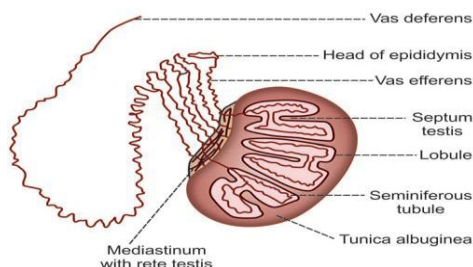
3. Tunica Vaginalis

- Tunica vaginalis is the outermost closed cleft like covering, formed by **mesothelial cells**.

PARENCHYMA OF TESTIS

Lobules of Testis

- ✓ Tunica albuginea on the posterior surface of testis is thickened to form the **mediastinum testis**.
- ✓ **From this**, the connective tissue septa called **septula testis radiate** into testis and bind with tunica albuginea at various points.
- ✓ Because of this, testis is divided into a number of **pyramidal lobules, with bases directed towards the periphery** and the apices towards the mediastinum
- ✓ The septula do not form complete partition so the lobules of testis anastomose with one another at many places.
- ✓ Each testis has about 200 to 300 lobules.



SEMINIFEROUS TUBULES:

- Seminiferous tubules are thread-like convoluted tubular structures which produce the spermatozoa or sperms.
- There are about 400 to 600 seminiferous tubules in each testis. Each tubule is 30 to 70 cm long with a diameter of 150 to 300 μ .

Wall of the seminiferous tubule is formed by three layers:

1. Outer capsule or tunica propria, formed by fibroelastic connective tissue
2. Thin homogeneous basement membrane
3. Complex stratified epithelium, which consists of two types of cells:
 - i. Spermatogenic cells or germ cells
 - ii. Sertoli cells or supporting cells.

Spermatogenic Cells

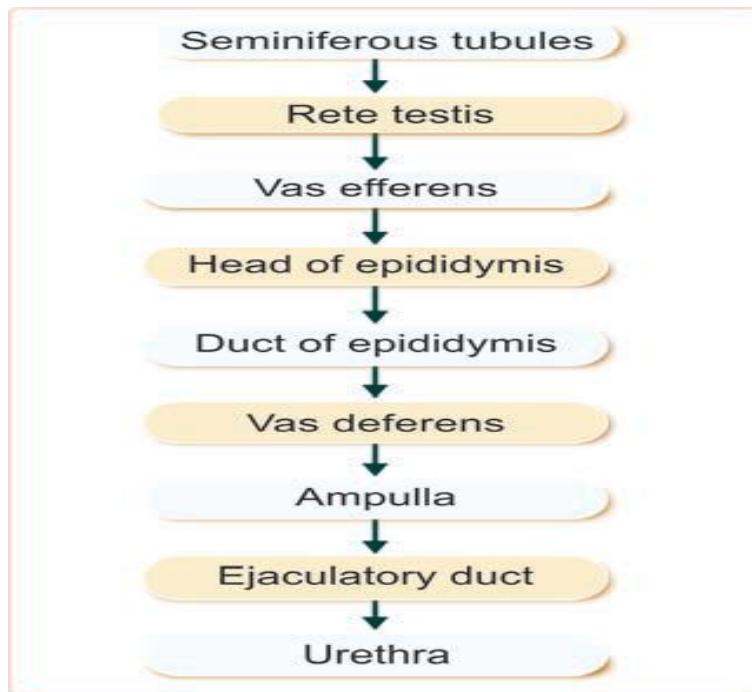
- ✓ Spermatogenic cells or germ cells present in seminiferous tubules are precursor cells of spermatozoa.
- ✓ These cells lie in between Sertoli cells and are arranged in an orderly manner in 4 to 8 layers.
- ✓ In children, the testis is not fully developed. Therefore, the spermatogenic cells are in primitive stage called spermatogonia.
- ✓ With the onset of puberty, spermatogonia develop into sperms through different stages.

Stages of spermatogenic cells

Different stages of spermatogenic cells seen from periphery to the lumen of seminiferous tubules are:

1. Spermatogonium
2. Primary spermatocyte
3. Secondary spermatocyte
4. Spermatid.

PATHWAY FOR SPERM PASSAGE



Rete Testis

Rete testis is a network of thin-walled channels present in mediastinum. All the seminiferous tubules open into the rete testis.

Vas Efferens

From rete testis, 8 to 15 tubules called vas efferens arise. Vas efferens join together and form the head of epididymis and then converge to form the duct of epididymis (Fig. 74.3).

Epididymis

Duct of epididymis is an enormously convoluted tubule, with a length of about 4 meter. It begins at head, whereit receives vas efferens.

Vas Deferens

At the caudal pole of testis, epididymis turns sharply upon itself and continues as vas deferens, without any definite demarcation.

Interstitial Cells of Leydig

Interstitial cells of Leydig are the hormone secreting cells of testis, lying in between the seminiferous tubules.

Sertoli Cells

Sertoli cells are the **supporting cells for spermatogenic** cells in seminiferous tubules. These cells are also called **sustentacular cells or nurse cells**.

Functions of Sertoli cells:

1. Support and **nourish the spermatogenic cells till the** spermatozoa are released from them
2. Secrete the enzyme **aromatase, which converts** androgens into estrogen
3. Secrete **androgen-binding protein (ABP), which is** essential for testosterone activity, especially during spermatogenesis
4. Secrete **estrogen-binding protein (EBP)**

FUNCTIONS OF TESTES:

Testes performs two functions:

1. Gametogenic function: Spermatogenesis
2. Endocrine function: Secretion of hormones.

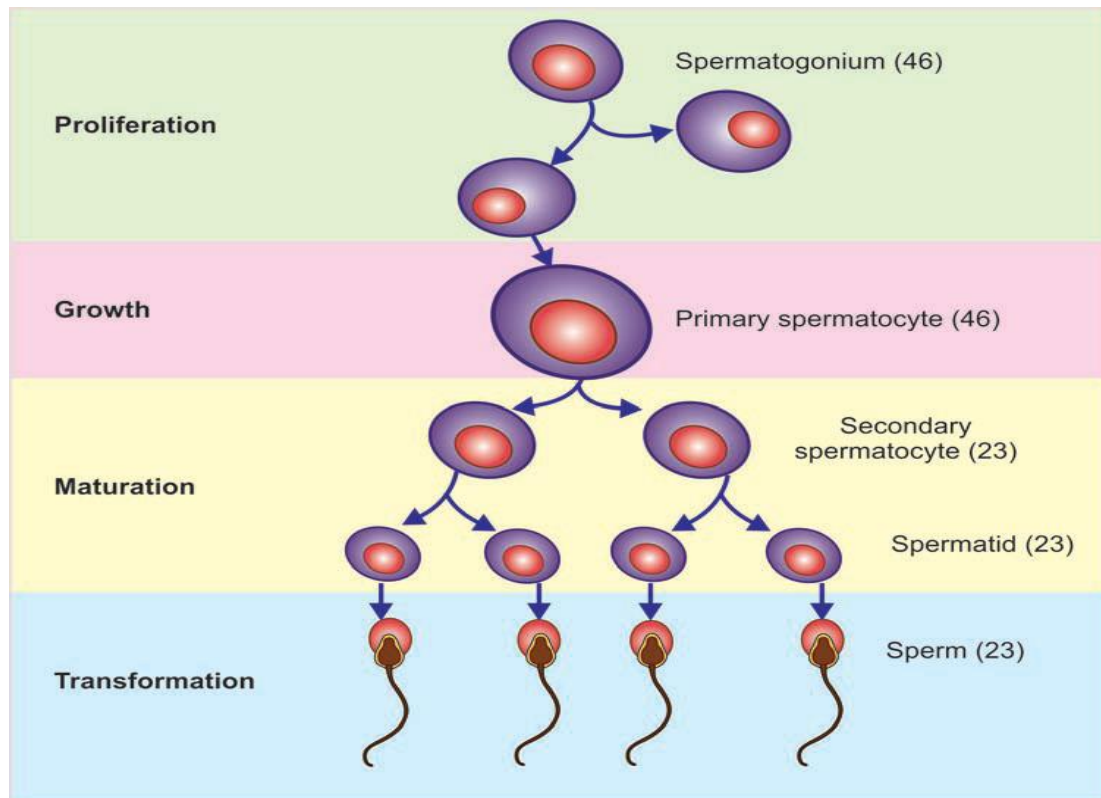
GAMETOGENIC FUNCTIONS OF TESTES – SPERMATOGENESIS

- ✓ Spermatogenesis is the process by which the male gametes called **spermatozoa (sperms) are formed from** the primitive **spermatogenic cells (spermatogonia) in** the testis .
- ✓ It takes 74 days for the formation of sperm from a **primitive germ cell**.
- ✓ **Throughout** the process of spermatogenesis, the spermatogenic cells have cytoplasmic attachment with Sertoli cells.
- ✓ **Sertoli cells supply all the necessary materials for** spermatogenesis through the cytoplasmic attachment.

STAGES OF SPERMATOGENESIS:

Spermatogenesis occurs in four stages:

1. Stage of proliferation
2. Stage of growth
3. Stage of maturation
4. Stage of transformation.



Spermatogenesis: Number in parenthesis indicate chromosomal number

1. Stage of Proliferation

- ✓ Each spermatogonium contains diploid number (23 pairs) of chromosomes.
- ✓ One member of each pair is from maternal origin and the other one from paternal origin.
- ✓ The 23 pairs include 22 pairs of autosomal chromosomes and one pair of sex chromosomes.
- ✓ Sex chromosomes are one X chromosome and one Y chromosome.
- ✓ During the proliferative stage, spermatogonia divide by mitosis, without any change in chromosomal number.
- ✓ In man, there are usually seven generations of spermatogonia.
- ✓ The last generation enters the stage of growth as **primary spermatocyte**.
- ✓ During this stage, the spermatogonia migrate along with Sertoli cells towards the lumen of seminiferous tubule.

2. Stage of Growth:

- ✓ In this stage, the primary spermatocyte grows into a large cell.

- ✓ Apart from growth, there is no other change in spermatocyte during this stage.

3. Stage of Maturation:

After reaching the full size, each primary spermatocyte quickly undergoes meiotic or maturation division, which occurs in two phases:

First phase

- ✓ In the first phase, each primary spermatocyte divides into two secondary spermatocytes.
- ✓ The significance of the first meiotic division is that each secondary spermatocyte receives only the haploid or half the number of chromosomes.
- ✓ 23 chromosomes include 22 autosomes and a X or a Y chromosome.

Second phase

- ✓ During this phase, each secondary spermatocyte undergoes second meiotic division, resulting in two smaller cells called spermatids.
- ✓ Each spermatid has haploid number of chromosomes.

4. Stage of Transformation:

Spermatids are transformed into matured spermatozoa (sperms), by means of spermeogenesis and released by spermination.

FACTORS AFFECTING SPERMATOGENESIS:

Spermatogenesis is influenced by:

1. Sertoli cells
2. Hormones
3. Other factors.

1. Role of Sertoli Cell in Spermatogenesis

Sertoli cells influence spermatogenesis by:

- i. Supporting and nourishing the germ cells
- ii. Providing hormonal substances necessary for spermatogenesis
- iii. Secreting androgen-binding protein (ABP), which is essential for testosterone activity, particularly on spermatogenesis
- iv. Releasing sperms into the lumen of seminiferous tubules (spermination).

2. Role of Hormones in Spermatogenesis:

Spermatogenesis is influenced by many hormones, which act either directly or indirectly: gives the hormones essential for each stage of spermatogenesis.

Hormones necessary for spermatogenesis are:

- i. Follicle-stimulating hormone (FSH)
- ii. Testosterone
- iii. Estrogen
- iv. Luteinizing hormone (LH)
- v. Growth hormone (GH)
- vi. Inhibin
- vii. Activin.

STAGE OF SPERMATOGENESIS HORMONES NECESSARY

Stage of proliferation	Follicle-stimulating hormone Growth hormone
Stage of growth	Testosterone Growth hormone
Stage of maturation	Testosterone Growth hormone
Stage of transformation	Testosterone Estrogen

ENDOCRINE FUNCTIONS OF TESTES-HORMONES SECRETED BY TESTES:

- ✓ Testes secrete male sex hormones, which are collectively called the **androgens**.
- ✓ Androgen are responsible for secondary sexual characteristics in men including facial and body hair

Androgens secreted by testes are:

1. Testosterone
2. Dihydrotestosterone
3. Androstenedione.

TESTOSTERONE SECRETION IN DIFFERENT PERIODS OF LIFE:

- ✓ Testosterone secretion starts at 7th week of fetal life by fetal genital ridge.

- ✓ Fetal testes begin to secrete testosterone at about 2nd to 4th month of fetal life.
- ✓ In fetal life, testosterone secretion from testes is stimulated by human chorionic gonadotropins, secreted by placenta.
- ✓ But in childhood, practically no testosterone is secreted approximately until 10 to 12 years of age.
- ✓ Afterwards, the testosterone secretion starts and it increases rapidly at the onset of puberty and lasts through most of the remaining part of life.
- ✓ The secretion starts decreasing after 40 years and becomes almost zero by the age of 90 years

FUNCTIONS OF TESTOSTERONE:

In general, testosterone is responsible for the distinguishing characters of masculine body. It also plays an important role in fetal life.

Functions of Testosterone in Fetal Life:

Testosterone performs three functions in fetus:

1. Sex differentiation in fetus
2. Development of accessory sex organs
3. Descent of the testes

