Morphology and capsules of the testes.

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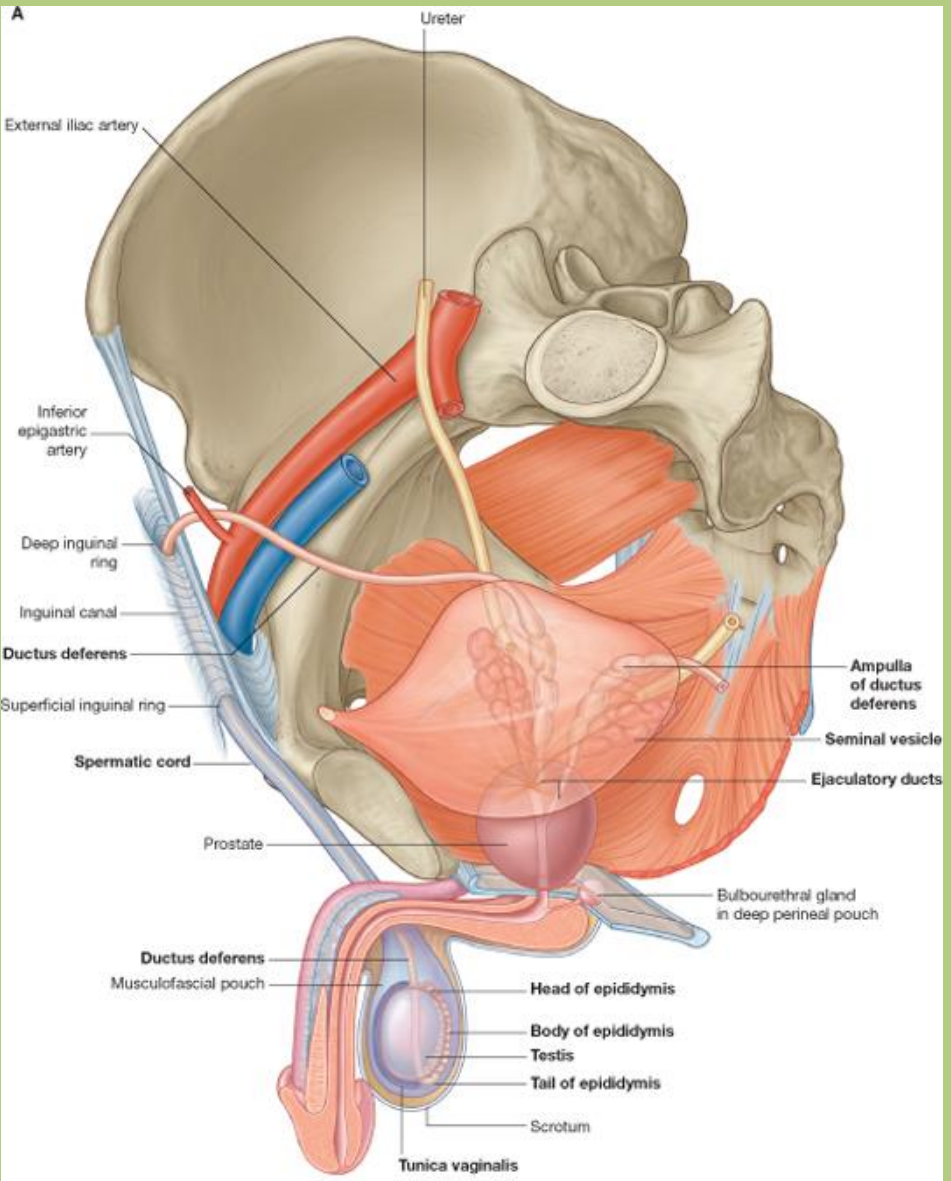
Male reproductive organs



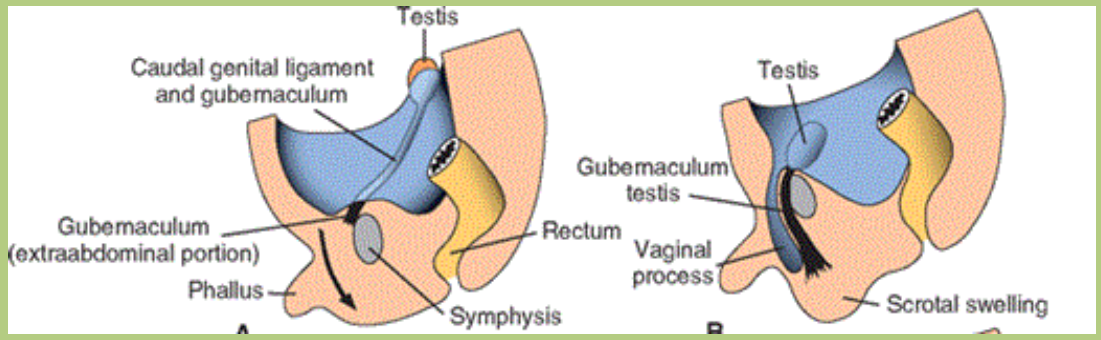
Internal components:

1. Gonad – testes
2. Duct – system: epididymis, deferent duct, ejaculatory duct
3. Additional glands: seminal vesicle, prostate gland, bulbourethral gland

External component:

Penis

Steps of descent of the testes



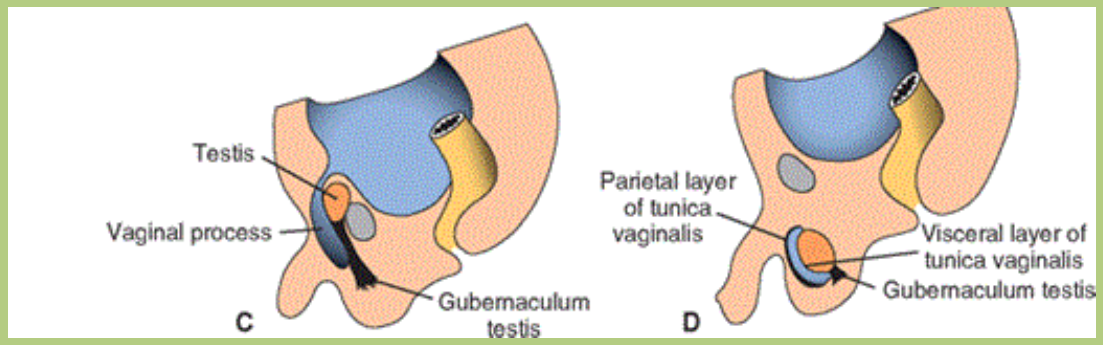
1. At the end of the second month, the ***urogenital mesentery*** attaches the testis and mesonephros to the posterior abdominal wall.

2. Degeneration of mesonephros.

3. Mesentery caudally becomes ligamentous, known as ***caudal genital ligament***. A mesenchymal condensation from the caudal pole of testis also arises, known as ***gubernaculum***.

4. Gubernaculum terminates in the inguinal region between the differentiating internal and external oblique muscles and later grows toward the scrotal floor.

Steps of descent of the testes



5. Independently from the descent, the ***peritoneum forms an evagination (=processus vaginalis)*** on each side of the midline into the ventral abdominal wall.

6. The ***processus vaginalis follows the course of the gubernaculum*** into the scrotal swellings.

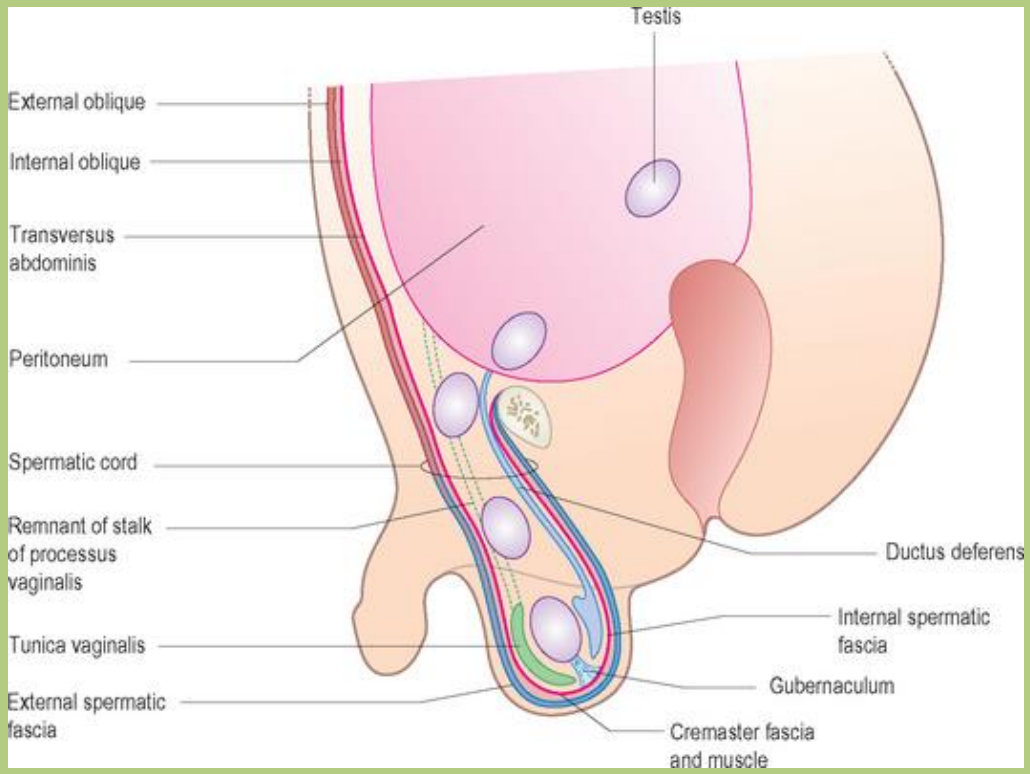
7. Hence, the ***processus vaginalis*** , accompanied by the muscular and fascial layers of the body wall, ***evaginates into the scrotal swelling, forming the inguinal canal***.

8. The testis is then covered by a reflected fold of the processus vaginalis. The ***peritoneal layer covering of testis is the visceral layer*** of tunica vaginalis. The ***remainder of the peritoneal sac forms the parietal layer*** of the tunica vaginalis.

9. In addition the ***testis becomes ensheathed in layers derived from the anterior abdominal wall trough which it passes***.

Descent of the testes

under the influence of androgens and anti müllerian hormone



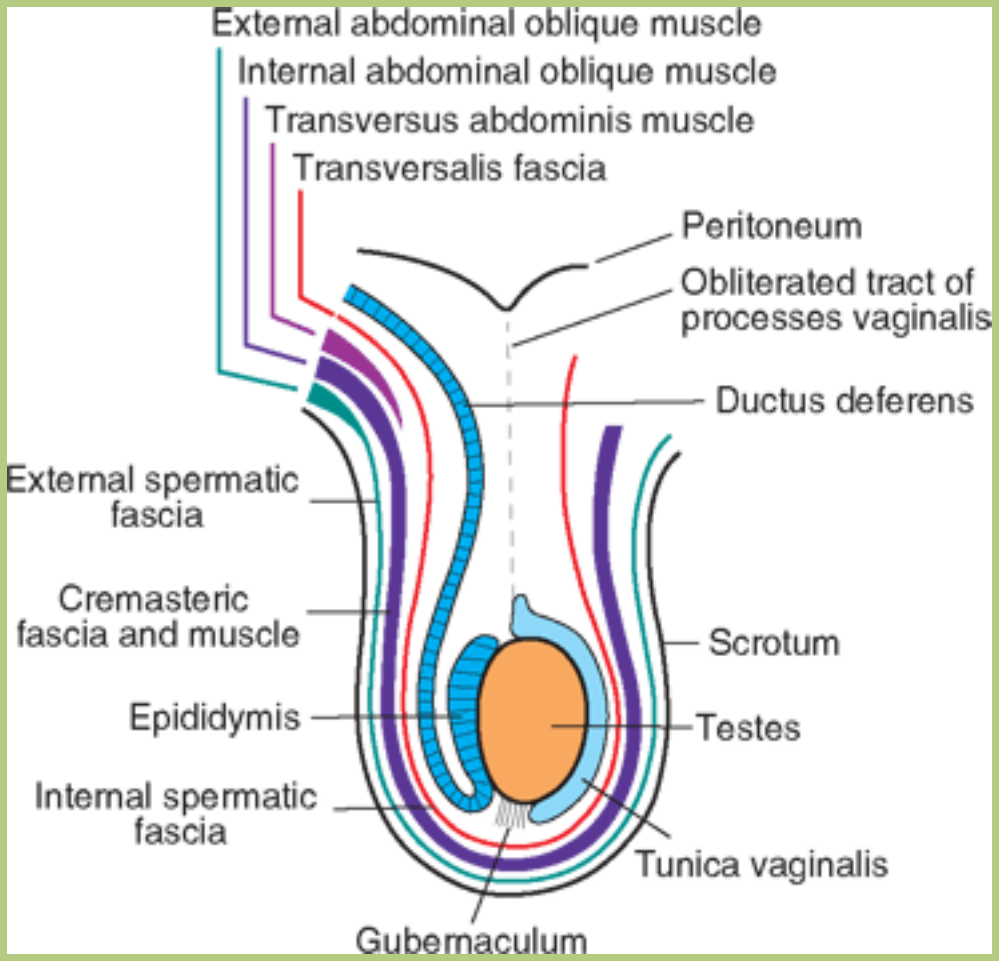
Week 8 (posterior abdominal wall)

Week 12 (inguinal region)

Week 28 (end of inguinal canal)

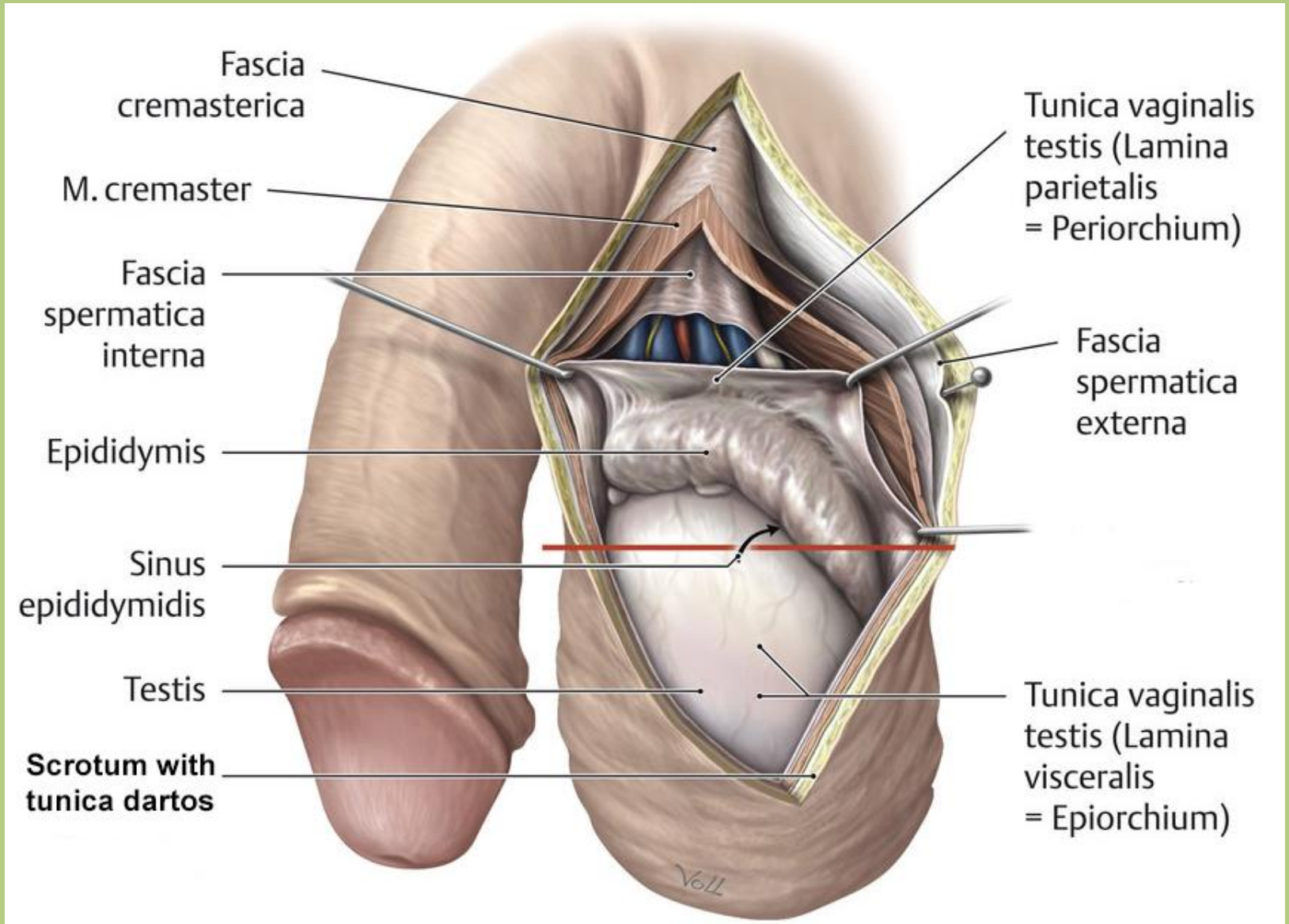
Week 33 (scrotum)

Capsules of the testis

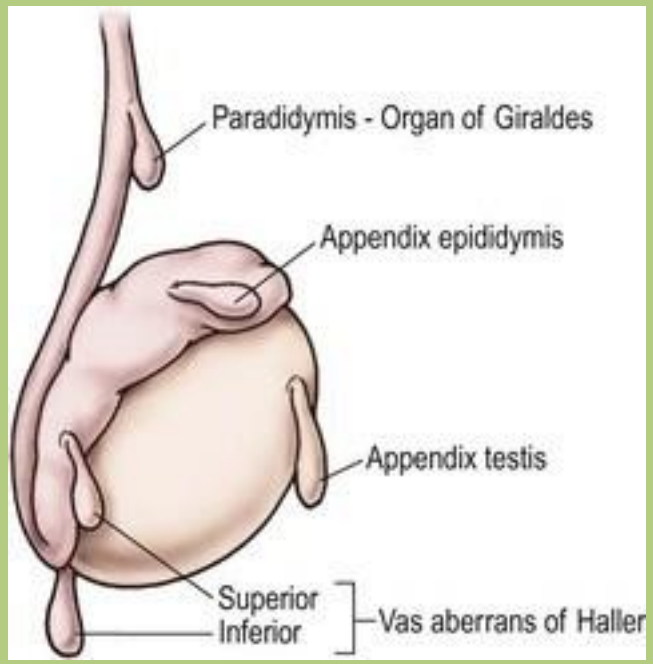


Layers of the abdominal wall	Counterpart (coverings of the testis)
Abdominal (perineal) skin	***Scrotum***
Superficial fascia	***Tunica dartos***
External oblique muscle	***External spermatic fascia***
Internal oblique muscle	***Cremaster muscle and its fascia***
Transversus abdominis	No counterpart because it does not cover the path of migration
Transversalis fascia	***Internal spermatic fascia***
Peritoneum	***Tunica vaginalis***

Capsules of the testis



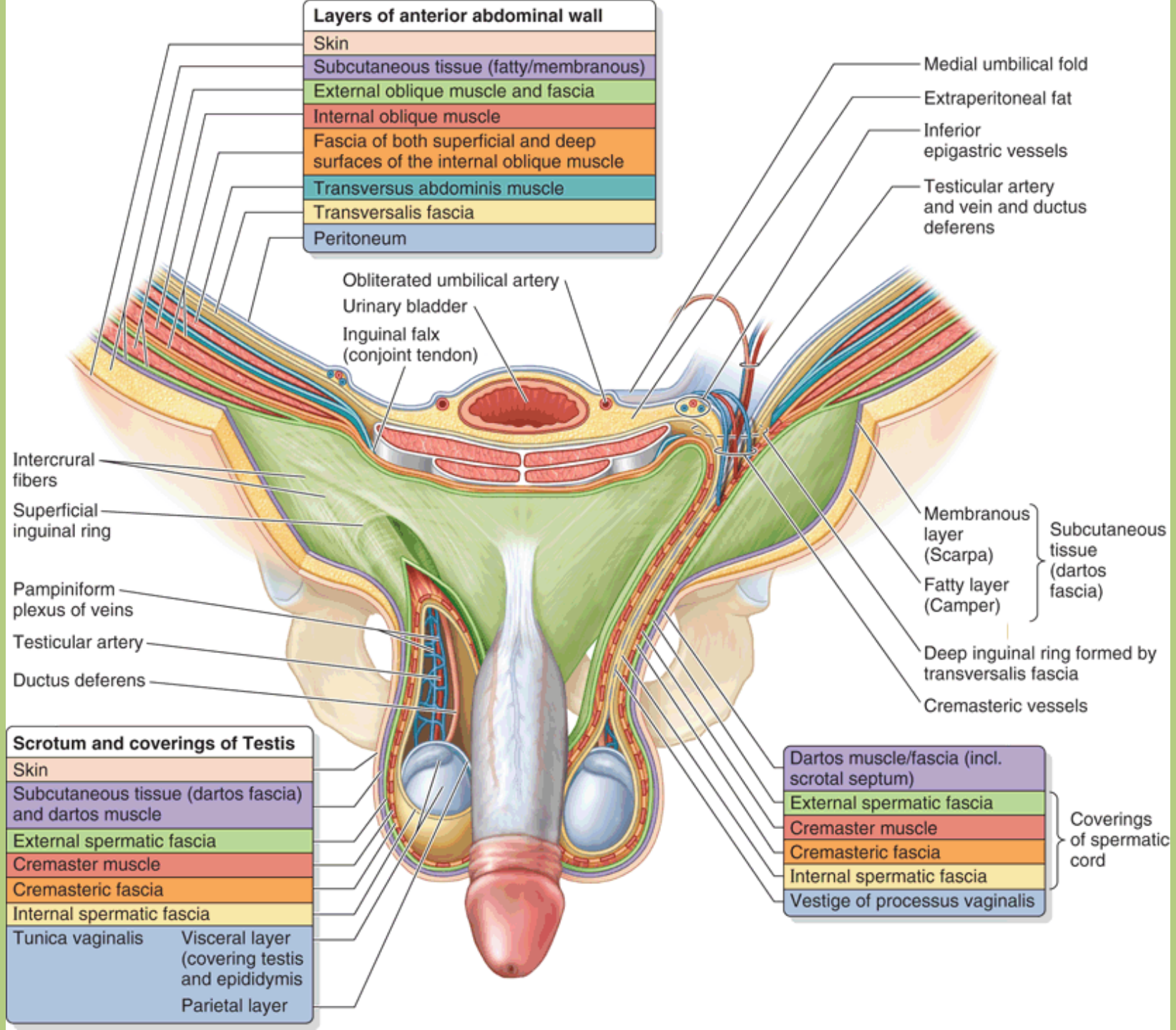
Appendix testis and appendix epididymis



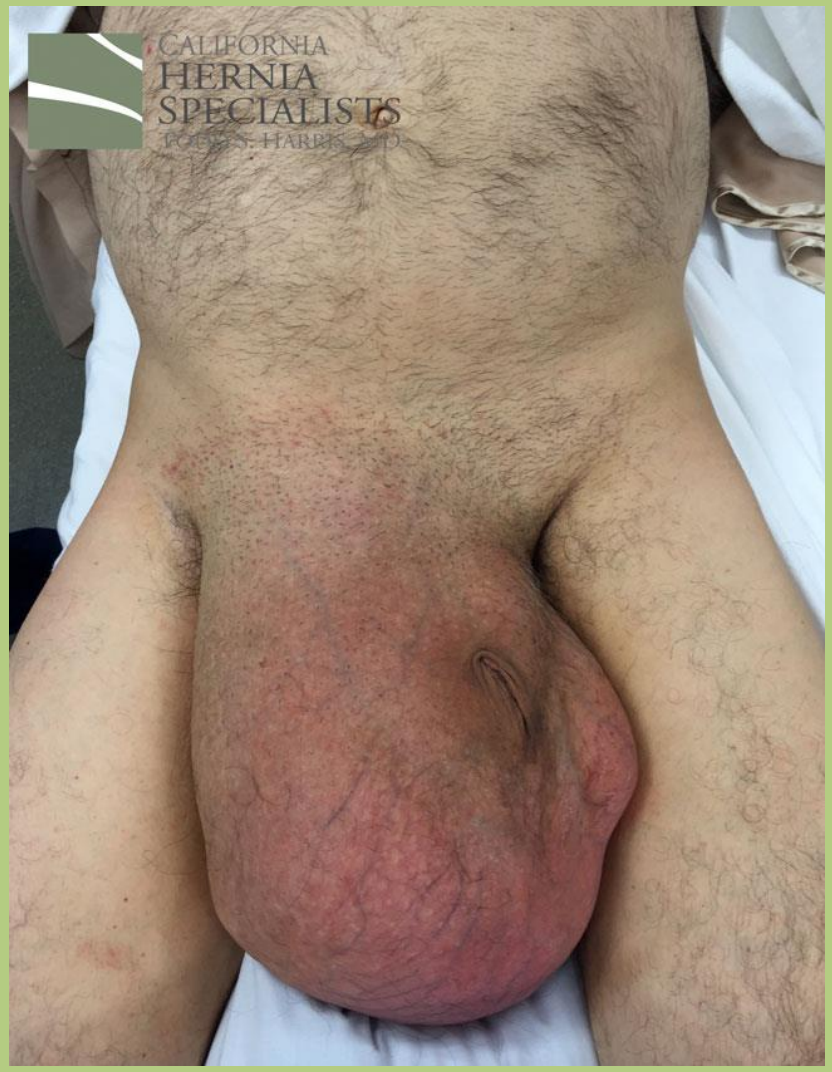
Under the influence of anti müllerian hormone produced by Sertoli cells, paramesonephric (Müllerian) ducts in male degenerate except a small portion at the cranial pole: **appendix testis.** It is presented in the 90% of the male population.

Mesonephric (Wolfian) ducts persist and form the main male genital ducts. The **appendix epididymis** is derived from the mesonephric duct as opposed to the appendix testis.

Capsules of the testis


Layers of anterior abdominal wall
Skin
Subcutaneous tissue (fatty/membranous)
External oblique muscle and fascia
Internal oblique muscle
Fascia of both superficial and deep surfaces of the internal oblique muscle
Transversus abdominis muscle
Transversalis fascia
Peritoneum
Medial umbilical fold
Extraperitoneal fat
Inferior epigastric vessels
Testicular artery and vein and ductus deferens
Obliterated umbilical artery
Urinary bladder
Inguinal falx (conjoint tendon)
Intercrural fibers
Superficial inguinal ring
Pampiniform plexus of veins
Testicular artery
Ductus deferens
Membranous layer (Scarpa)
Fatty layer (Camper)
Subcutaneous tissue (dartos fascia)
Deep inguinal ring formed by transversalis fascia
Cremasteric vessels
Scrotum and coverings of Testis
Skin
Subcutaneous tissue (dartos fascia) and dartos muscle
External spermatic fascia
Cremaster muscle
Cremasteric fascia
Internal spermatic fascia
Tunica vaginalis
Visceral layer (covering testis and epididymis
Parietal layer
Dartos muscle/fascia (incl. scrotal septum)
External spermatic fascia
Cremaster muscle
Cremasteric fascia
Internal spermatic fascia
Vestige of processus vaginalis
Coverings of spermatic cord

Inguinal hernia



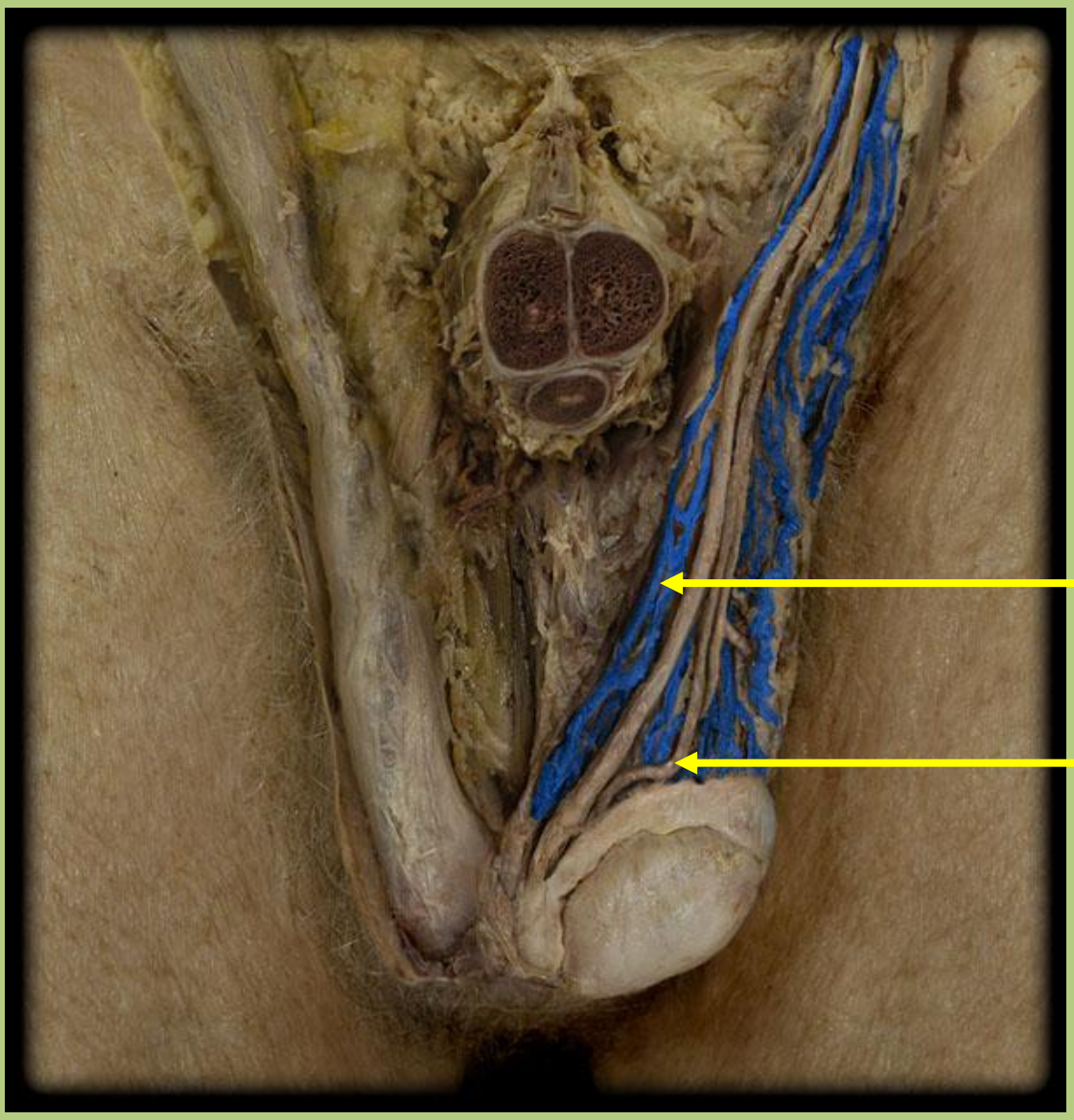
The connection between the abdominal cavity and the processus vaginalis in the scrotal sac normally closes in the first year after birth. If the this passageway remains open, intestinal loops may descend into the scrotum, causing a congenital indirect inguinal hernia.

Cryptorchidism

In 97% of male newborns, testes are present in the scrotum before birth. In most of the remainder, descent will be completed during the first 3 months postnatally. In less than 1% of infants, one or both testes fail to descend (=cryptorchidism). It may be caused by decreased androgen production.

Testis

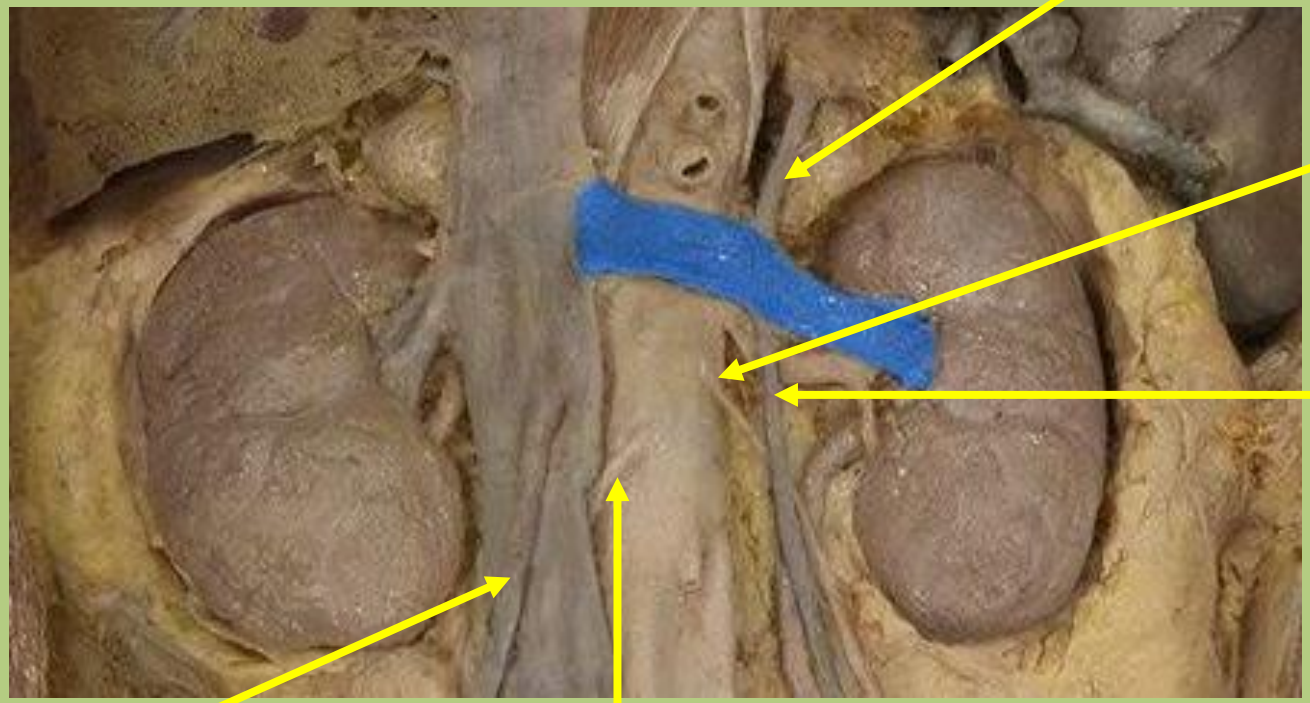
Testis - blood supply



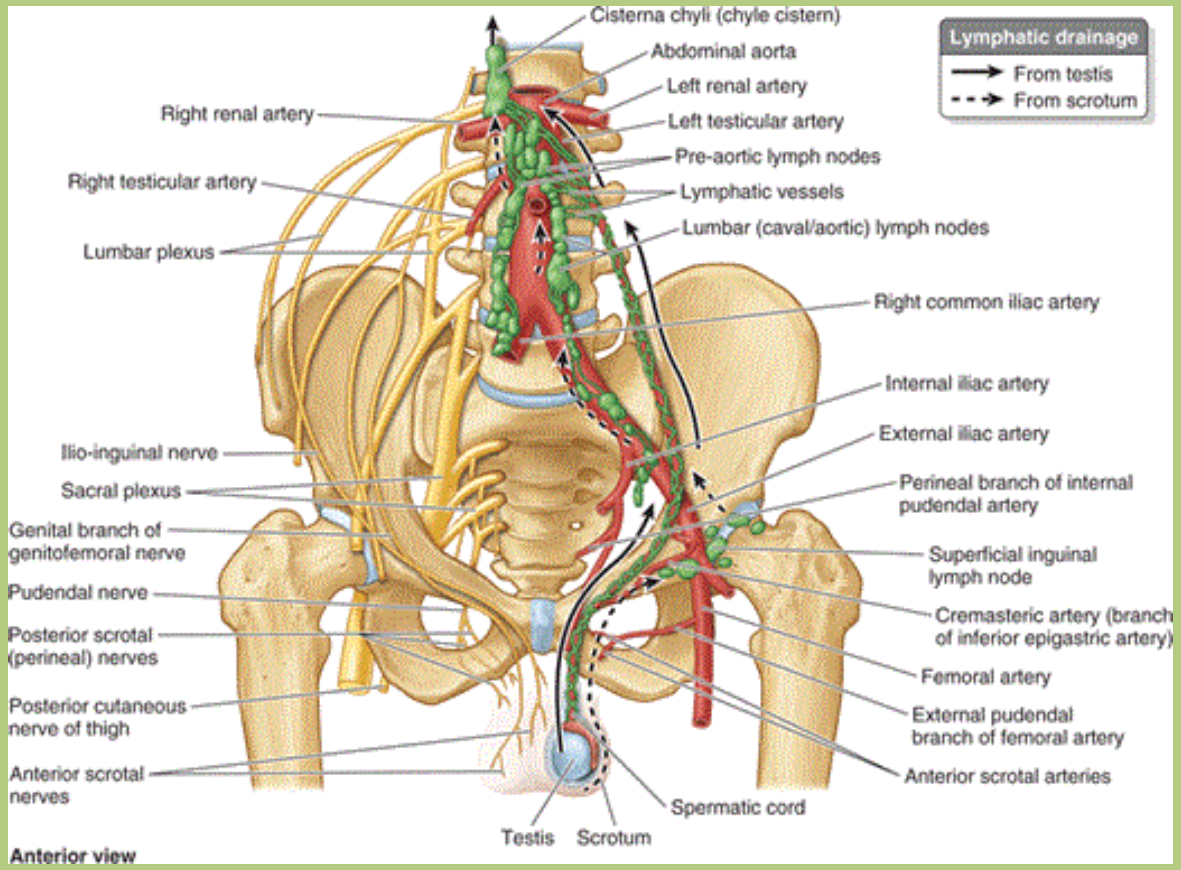
pampiniform plexus (testicular vein)

testicular artery (from the abdominal aorta at the level of L1/L2)

Testis - blood supply



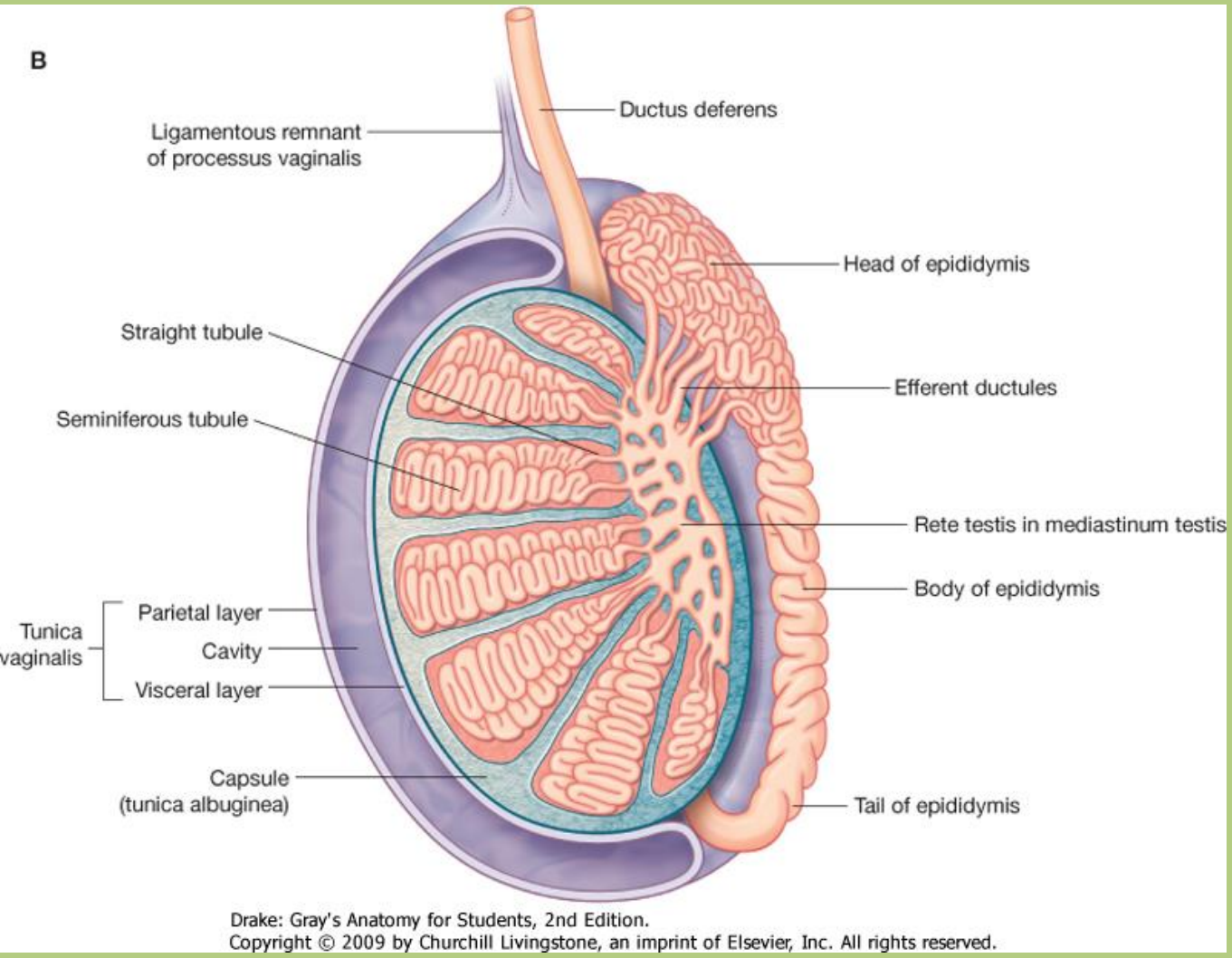
Testis - lymphatic drainage



From testes to the lumbar lymph nodes

From scrotum to the superficial inguinal lymph nodes

Testis - overview



Location: in a skin pouch- ***scrotum***.

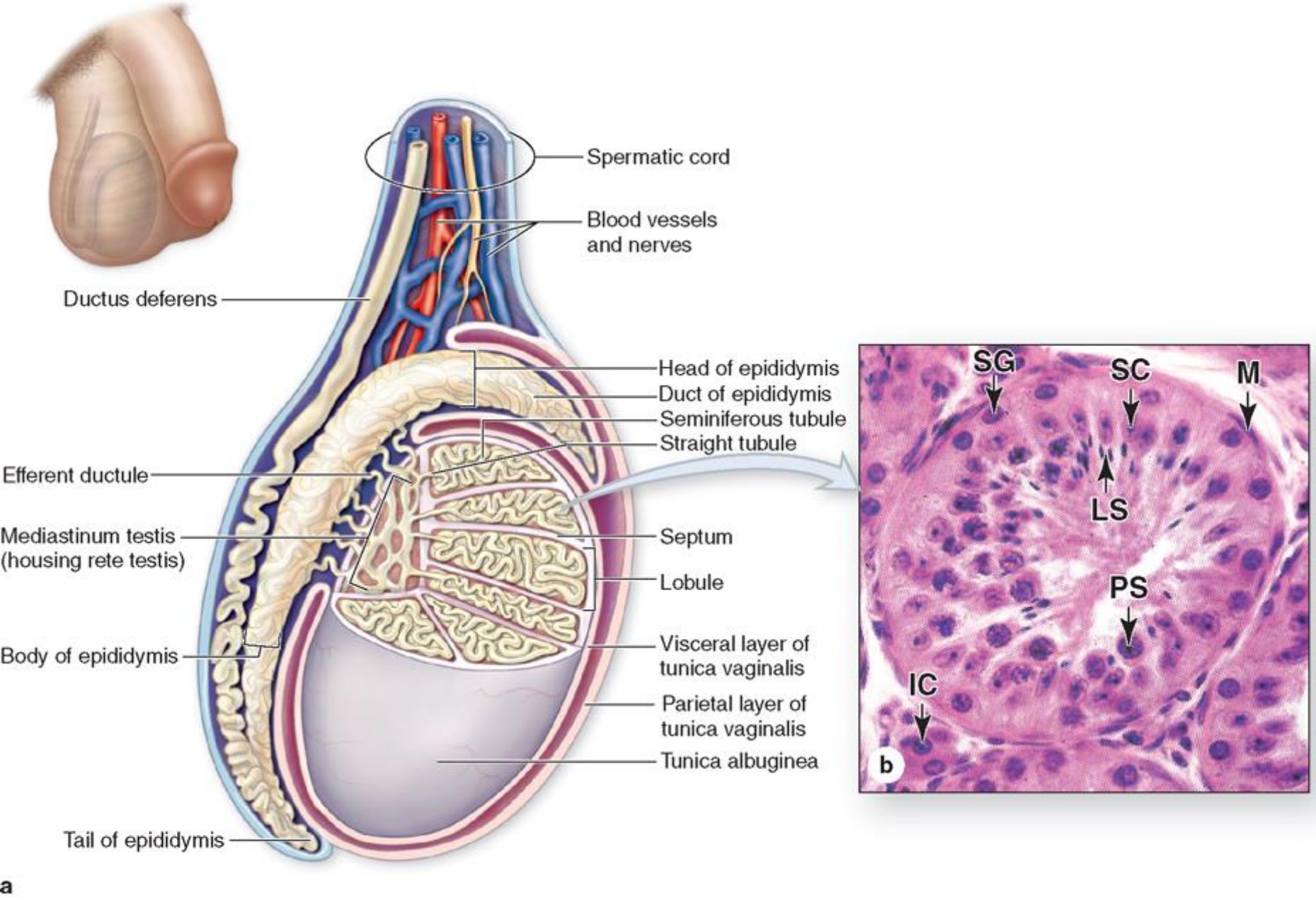
Forms ***sperm***.

Produces ***testosterone***.

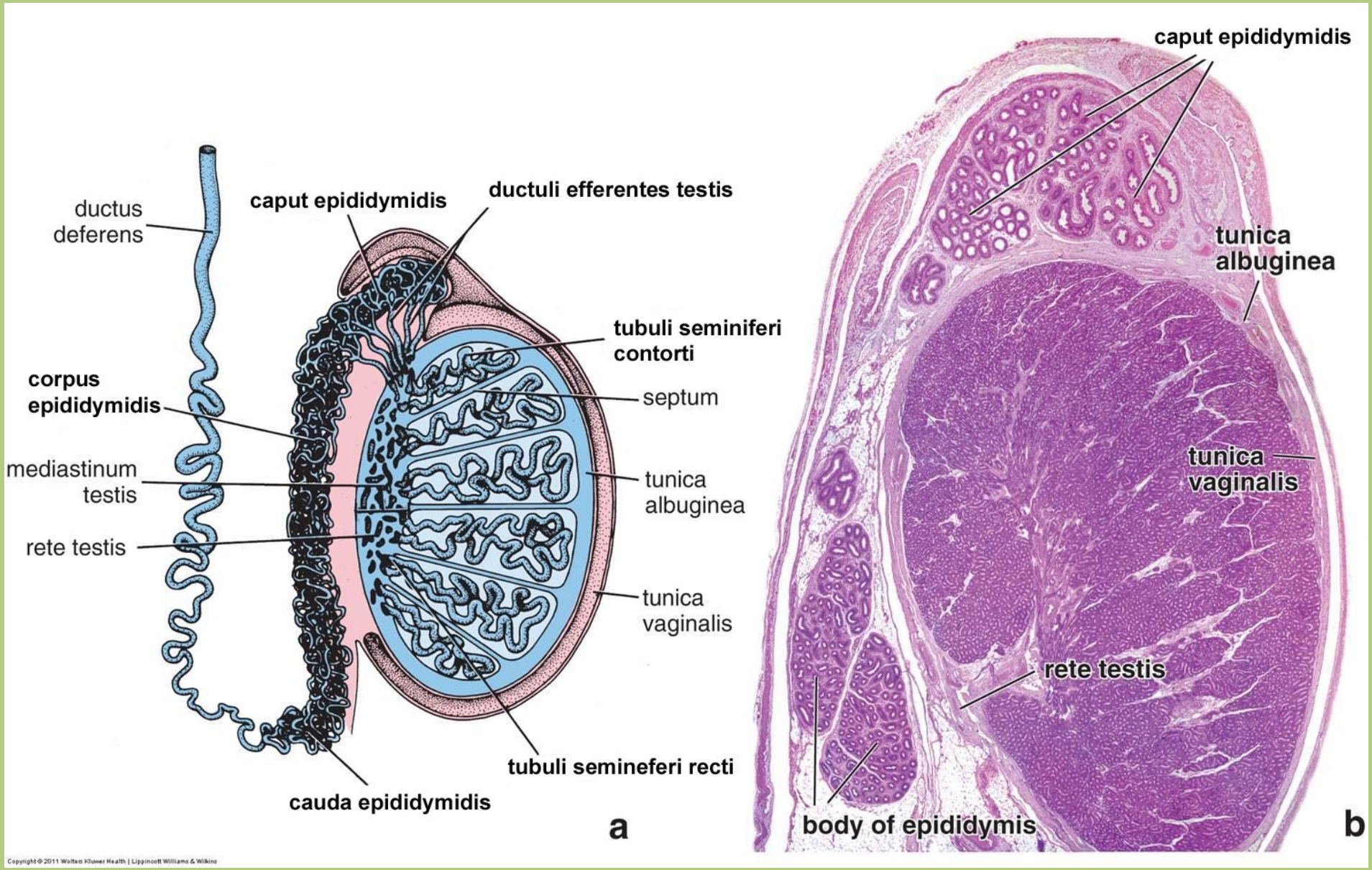
Connective tissue capsule.

Connective tissue septa – ***lobules***.

Lobules contain 2-3 ***seminiferous tubules***.



Histology of the testis



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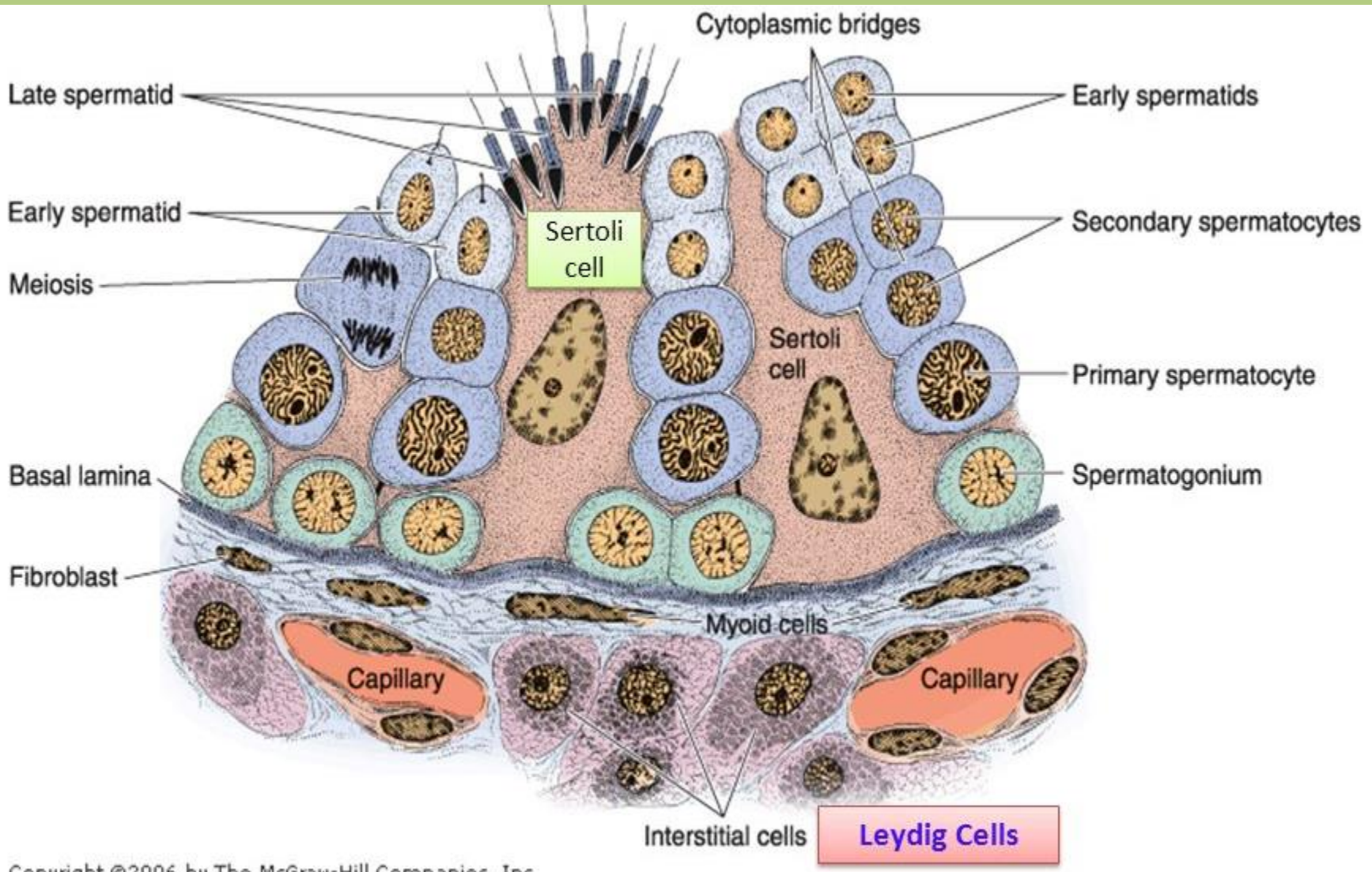
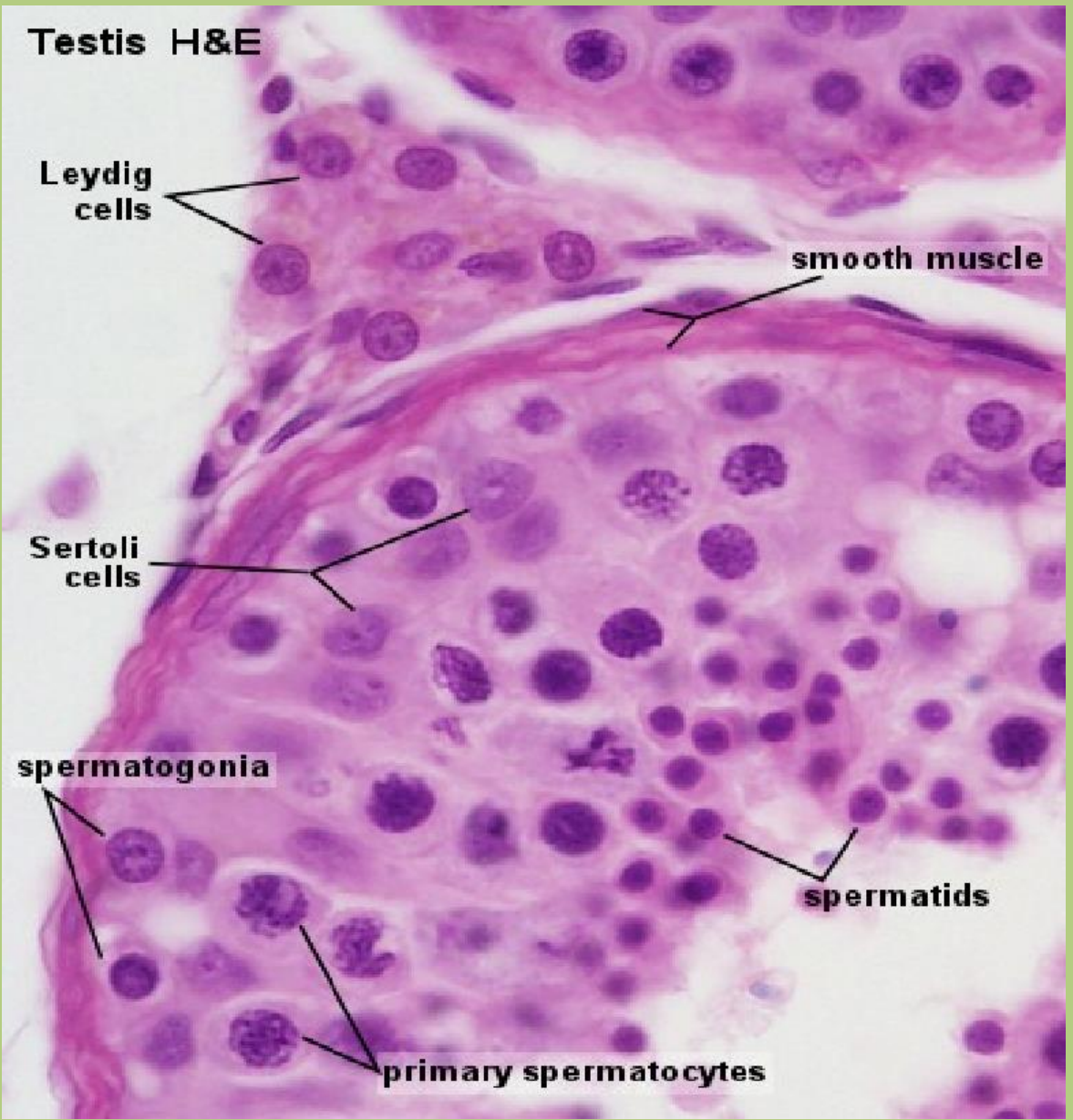


Leydig cells - interstitial cells



Leydig cells secrete ***testosterone*** from the early fetal life. Testosterone is required during embryonic development, sexual maturation and reproductive function:

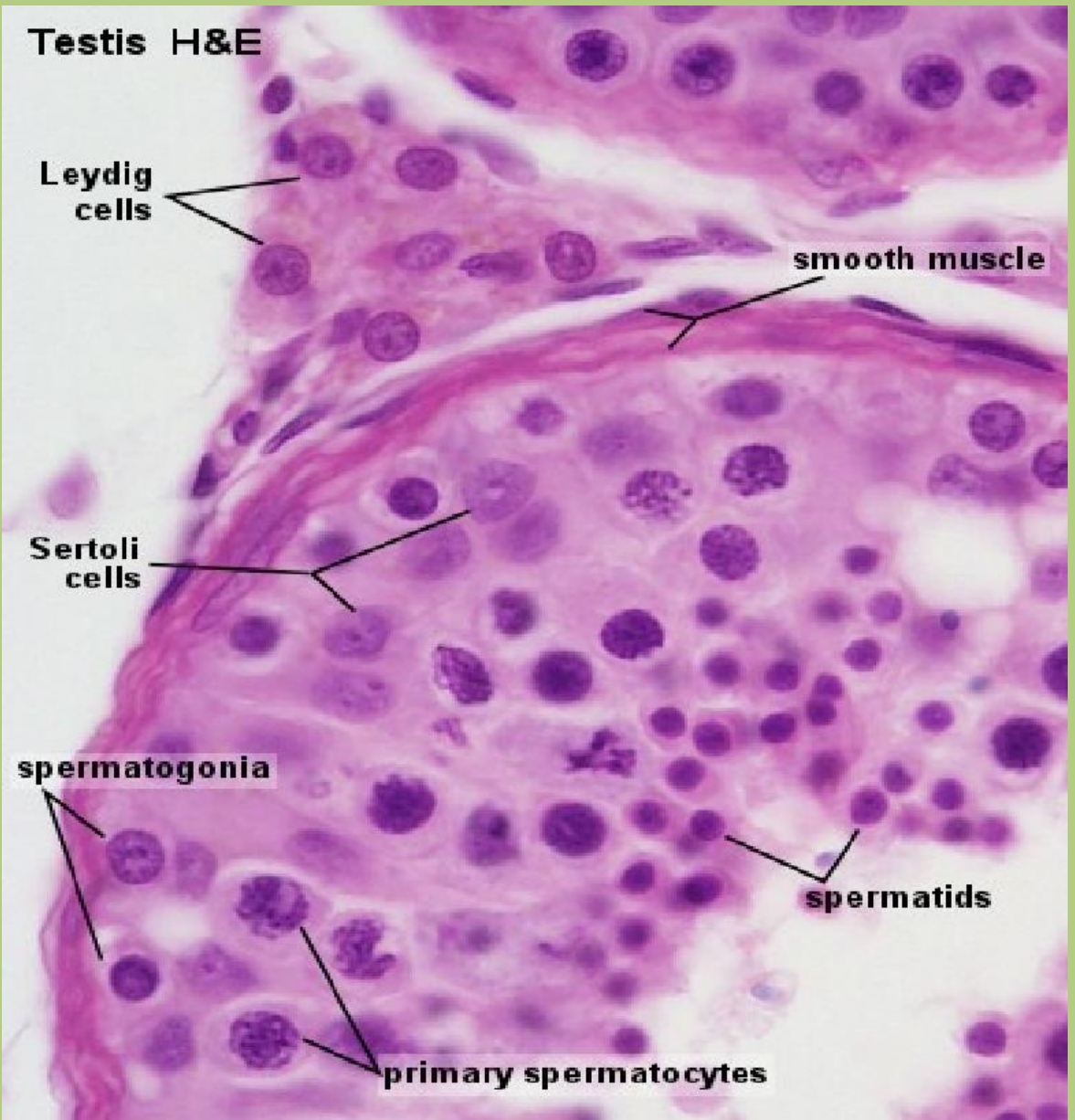
In the embryo, testosterone and other androgens are essential for the normal gonadal development.

At the puberty, testosterone is responsible for the initiation of sperm production, accessory sex gland secretion, and development of secondary sex characteristics.

In the adult, testosterone is essential for the maintenance of spermatogenesis and of secondary sex characteristics, and accessory sex glands.

Sertoli cells

supporting function



Tall columnar, non replicating epithelial cells that rest on the multilayered basal lamina of the seminiferous epithelium.

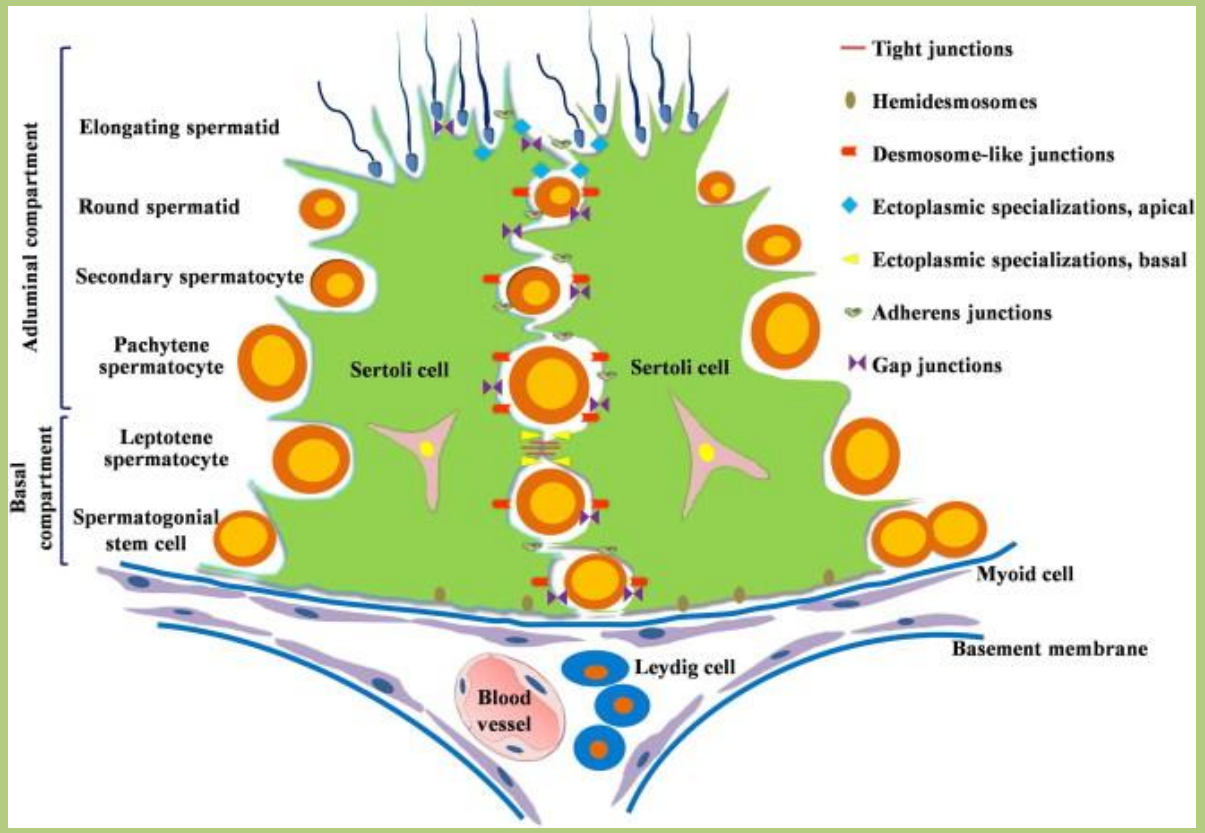
The Sertoli cell-to-Sertoli cell junctional complex *(**tight junction** that includes more than 50 parallel fusion lines in the adjacent membranes)* divides the seminiferous epithelium into basal and luminal compartments:

Spermatogonia and early primary spermatocytes are restricted to the basal compartment.

More mature spermatocytes and spermatids are restricted to the luminal side.

Sertoli cells

supporting function



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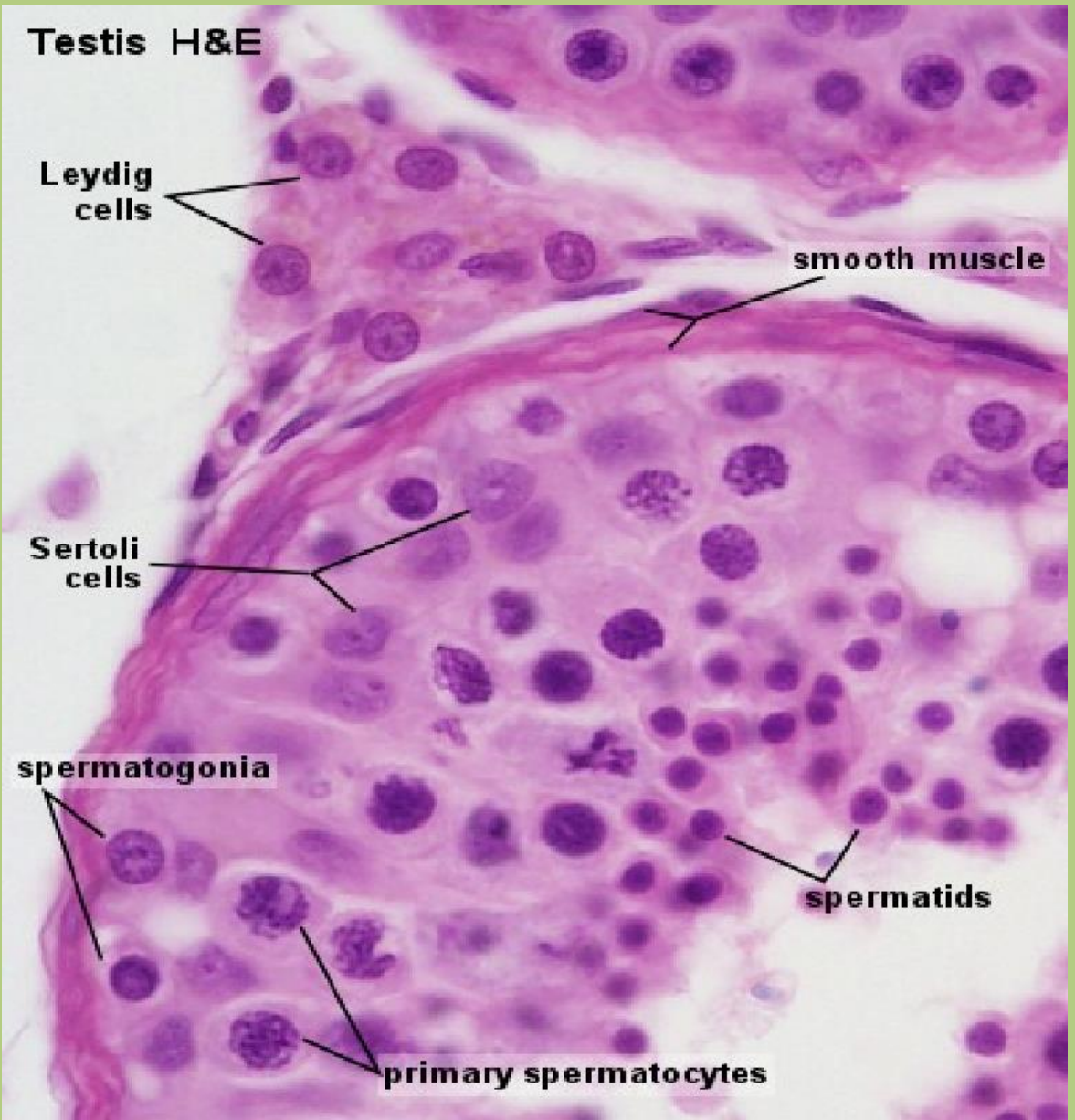
Sertoli cells - blood-testis barrier



The Sertoli cell-to-Sertoli cell junctional complex also forms a permeability barrier, creating a ***physiologic compertmentalization*** and a ***special micro environment*** (amino acids, carbohydrate, protein composition and ionic milieu). The blood-testis barrier insolates the genetically different and therefore antigenic haploid germ cells (secondary spermatocytes, spermatids and sperm cells) from the immune system.

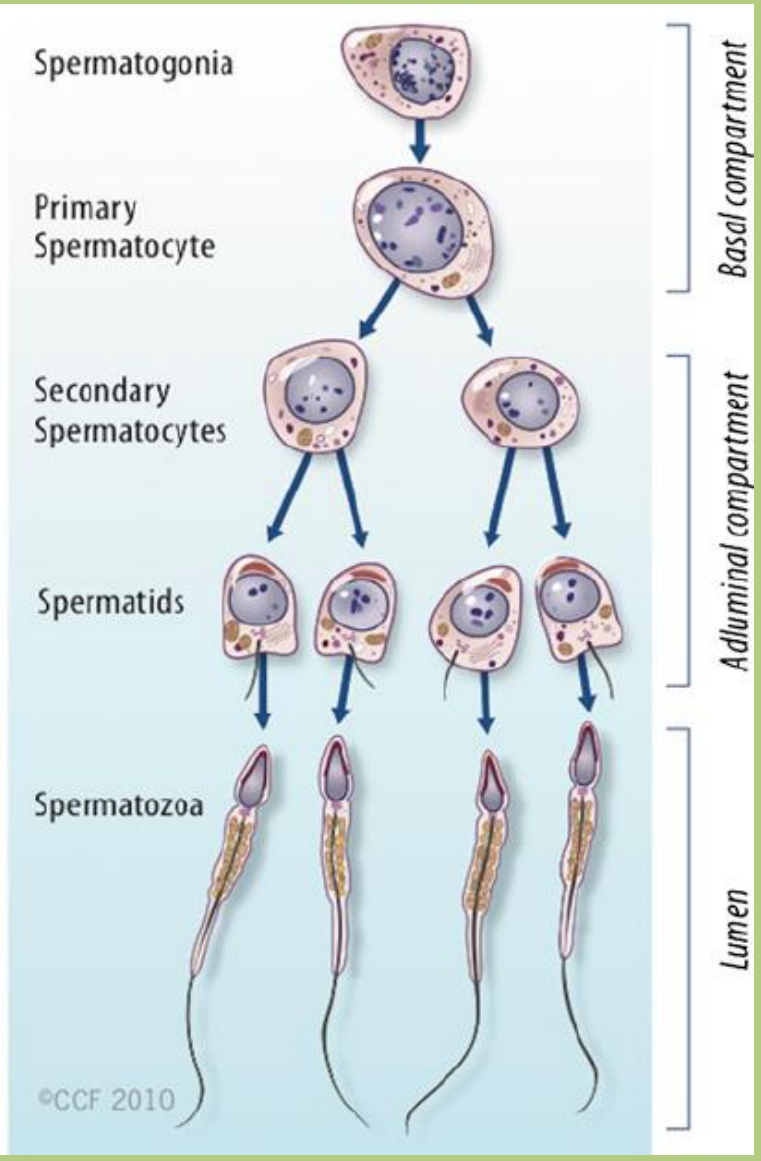
The exocrine secretory products of the Sertoli cells (particularly ***androgen-binding protein***) are highly concentrated in the lumen of the seminiferous tubules and maintain a high concentration of testosterone for the differentiating spermatogenic cells.

Sertoli cells also produce ***anti müllerian hormone.***

Spermatogenesis

Major Events in the Life of a Sperm

- Spermatogenesis
- Mitosis
- Meiosis
- Spermiogenesis
  - Head
  - Midpiece
  - Tail
- Capacitation
- Lifespan of a spermatozoa
  - Puberty through life
  - 30 x 10^6 per day
  - 60 to 75 days for sperm production
  - 10 to 14 days transport (epididymis)
  - 20 to 100 million per milliliter of ejaculate



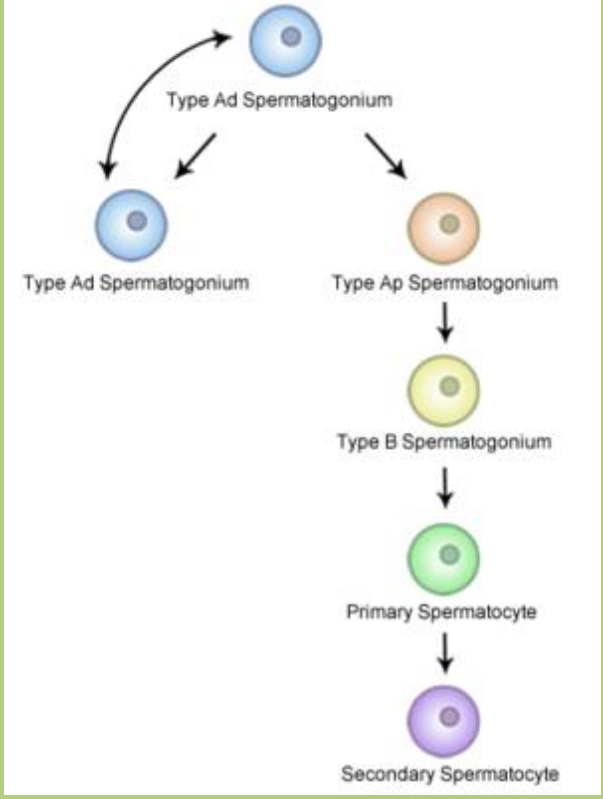
Spermatogenesis is the process by which ***spermatogonia develop into sperm***. It is divided into three distinct phases:

Spermatogonial phase

Spermatocyte phase (meiosis)

Spermatid phase (spermiogenesis)

Spermatogonial phase



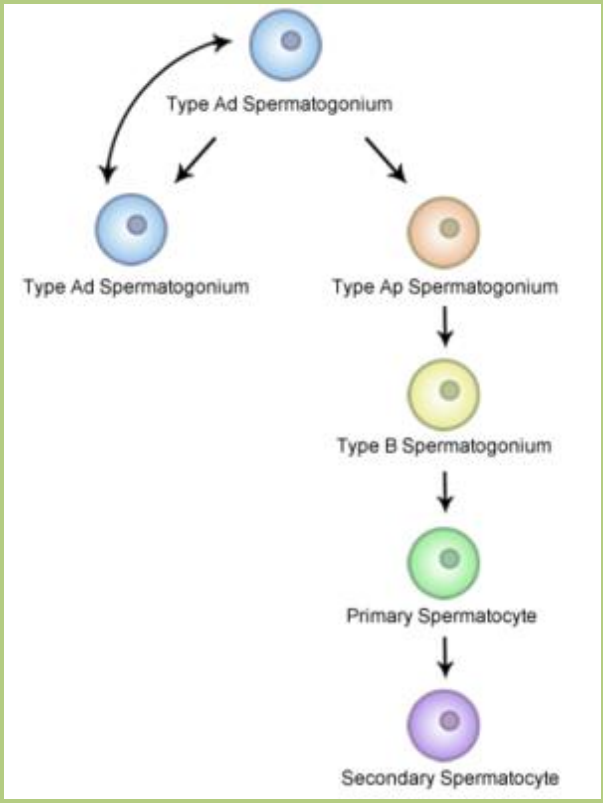
Spermatogonia divide by **mitosis** to replace themselves as well as provide a population of committed spermatogonia that will eventually differentiate into primary spermatocytes.

Type A dark (Ad) spermatogonia: Stem cells. They divide at regular intervals to give rise to either a pair of Ad spermatogonia that remain as stem cells or to a pair of type Ap spermatogonia.

Type A pale (Ap) spermatogonia: They are committed to the differentiation process that produces the sperm. They undergo several successive mitotic divisions.

Type B spermatogonia differentiate into primary spermatocyte.

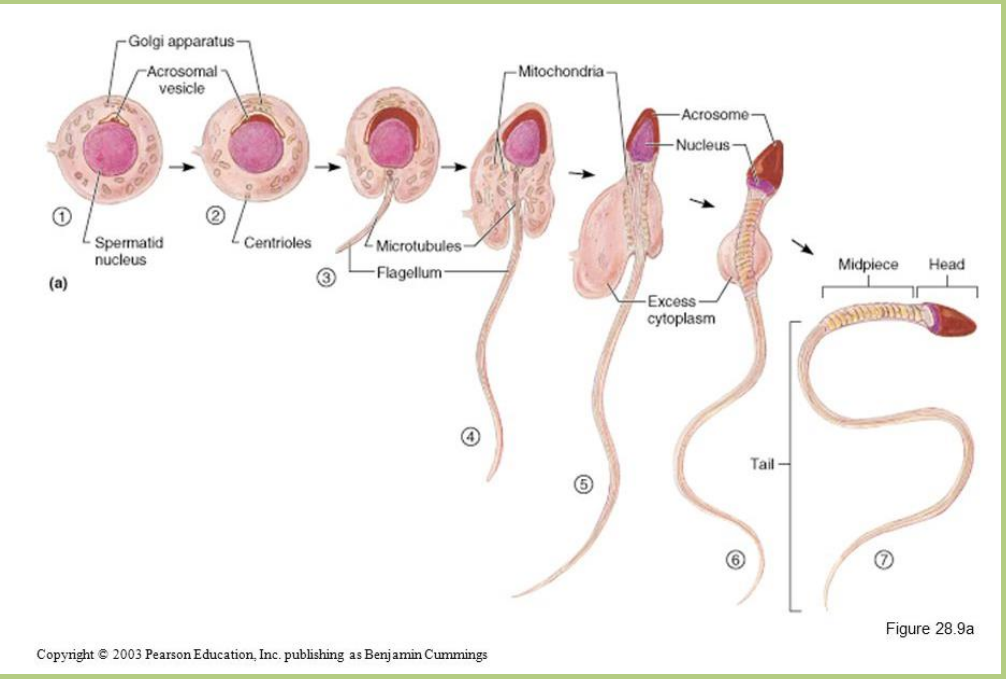
Spermatocyte phase - meiosis



Primary spermatocytes then enter a prolonged prophase (22 days) followed by rapid completion of meiosis I and formation of secondary spermatocytes.
During the second meiotic division, these cells immediately begin to form haploid spermatids.

Spermatogenesis is regulated by LH of pituitary gland. LH binds to receptors on Leydig cells and stimulates testosterone production, which in turns binds to Sertoli cells to promote spermatogenesis.
FSH helps the synthesis of intracellular androgen receptor proteins.

Spermatid phase - spermiogenesis



The series of changes resulting in the transformation of spermatids into spermatozoa is spermiogenesis.

These changes include:

- ***formation of acrosome,***
- ***condensation of the nucleus,***
- ***formation of neck, middle piece and tail, shedding of most of the cytoplasm as residual bodies that are phagocytozed by Sertoli cells***.

300 million sperm cells are produced daily.

When fully formed, spermatozoa enter the lumen of seminiferous tubules.

Cromosomal abnormalities

They are important causes of birth defects and spontaneous abortions. It is estimated that 50% conceptions end in spontaneous abortions and that 50% of these abortuses have major chromosomal abnormalities.

Klinefelter syndrome:

- found only in males
- sterility
- testicular atrophy
- hyalinization of the seminiferous tubules
- gynecomastia
- the cells have 47 chromosomes with a sex chromosomal complement of the XXY type, and a sex chromatin (Barr) body is found in 80% of cases
- 1 in 500 males

Thank you for your attention.

References: Gray's Anatomy for Students
Thieme, Atlas of Anatomy, Neck and Internal Organs
Elsevier, Kierszenbaum: Histology and Cell Biology: An Introduction to Pathology 2e
LWW: Langman's Medical Embryology
Pawlina: Histology, A Text and Atlas
WebPathology.com
studyblue.com