Morphology and histology of the testicle. Spermiogenesis.

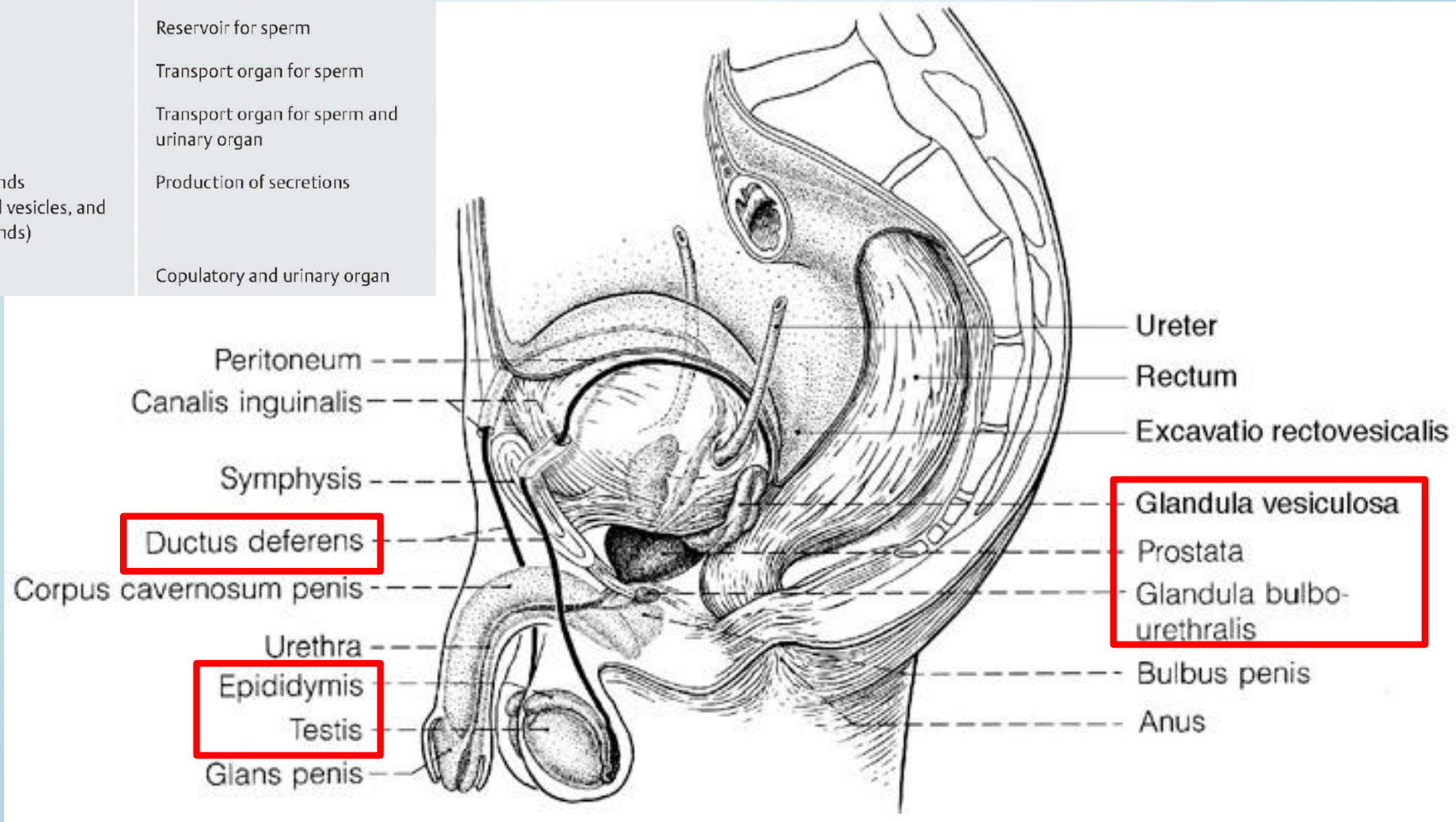
Ph.D, M.D. Dávid Lendvai
Anatomy, Histology and Embryology Institute
2019.

Michelangelo Buonarotti: David, 1501.

OVERVIEW OF THE MALE GENITAL TRACT

Functions of the male genital organs (table)

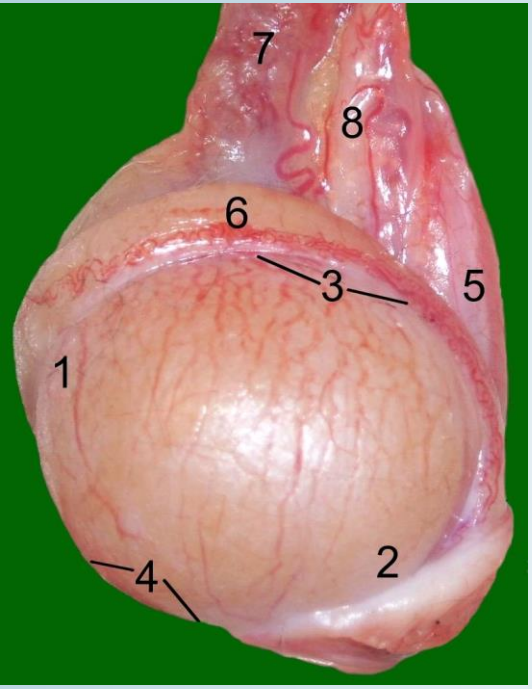
Organ	Function
Testis	Germ-cell production Hormone production
Epididymis	Reservoir for sperm
Vas deferens	Transport organ for sperm
Urethra	Transport organ for sperm and urinary organ
Accessory sex glands (prostate, seminal vesicles, and bulbourethral glands)	Production of secretions
Penis	Copulatory and urinary organ



TESTICLES - FUNCTIONS

- *Germ-cell production (Convoluted semiferous tubules):*
  - *Spermiogenesis*
  - *Spermiohistogenesis*
- *Testosteron production (Leydig-cells):*
  - *secondary gender characteristics*
  - *spermiogenesis*
  - *sexual activity (Libido)*
  - *anabolic effect*
  - *male behaviors*

TESTICLE

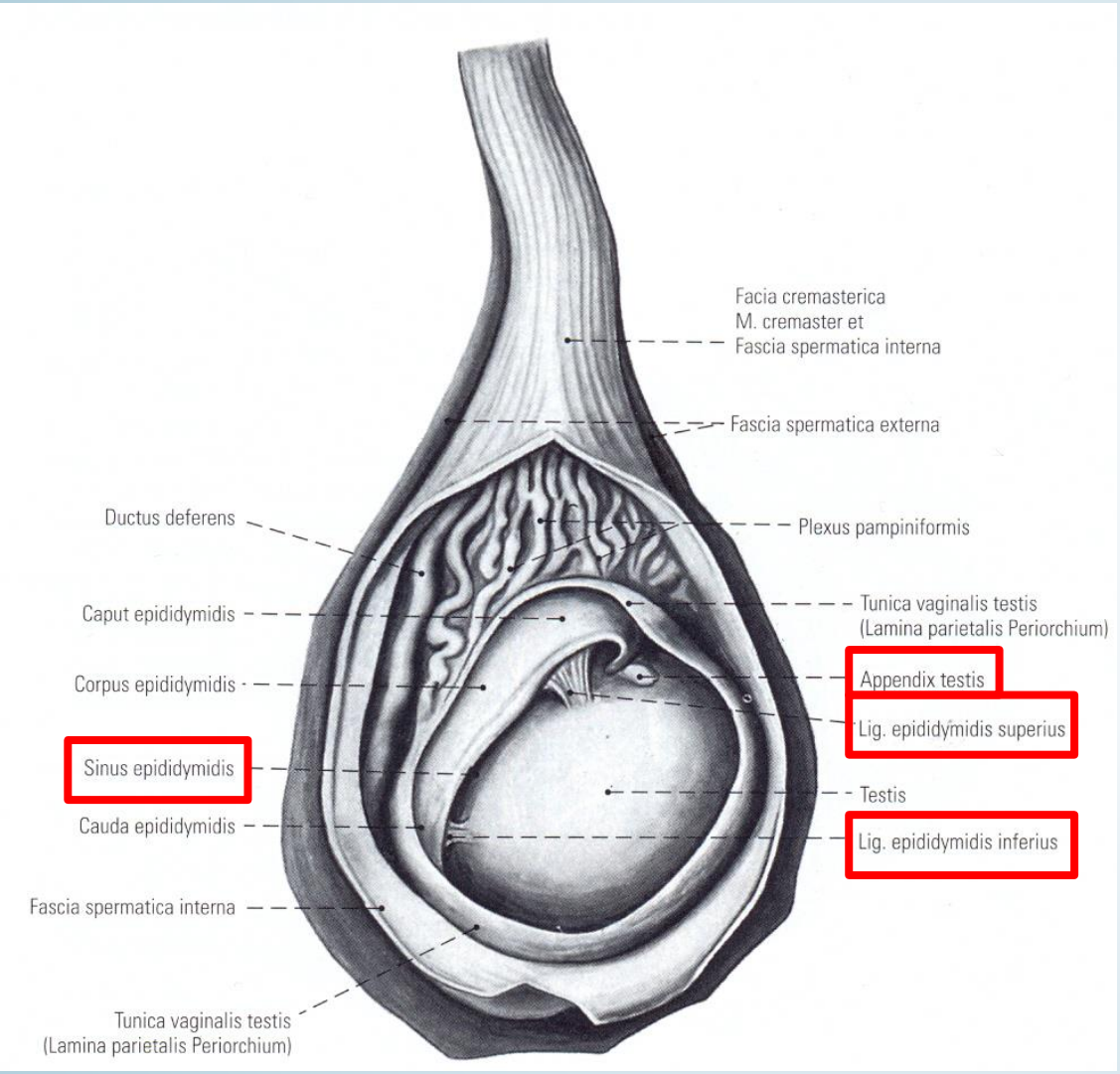


- Left is usually larger and it has a lower position in the scrotum
- 45º inclined forward
- 2 side surfaces : Facies med.
  Facies lat.
- 2 margins : Margo ant. (free) (4)
  Margo post. (with epididymis=6 together) (3)
- 2 Poles: Extremitas sup. (1)
  Extremitas inf. (2)

1 Extremitas sup.
2 Extremitas inf.
3 Margo post.
4 Margo ant.
5 Mesorchium
6 Epididymis
7 A. testicularis, Plexus pampiniformis
8 Ductus deferens

Testis		**Epididymis**	
Weight	ca. 20 g	Length of epididymal duct	
Length	ca. 4 cm	– Uncoiled	ca. 6 m
Width	ca. 2 cm	– Coiled	ca. 6 cm
350–370 testicular lobules			
Approximately 12 efferent ductules			

TESTICLE - STRUCTURES



Tunica vaginalis testis =

•Visceral lamina (Epiorchium)

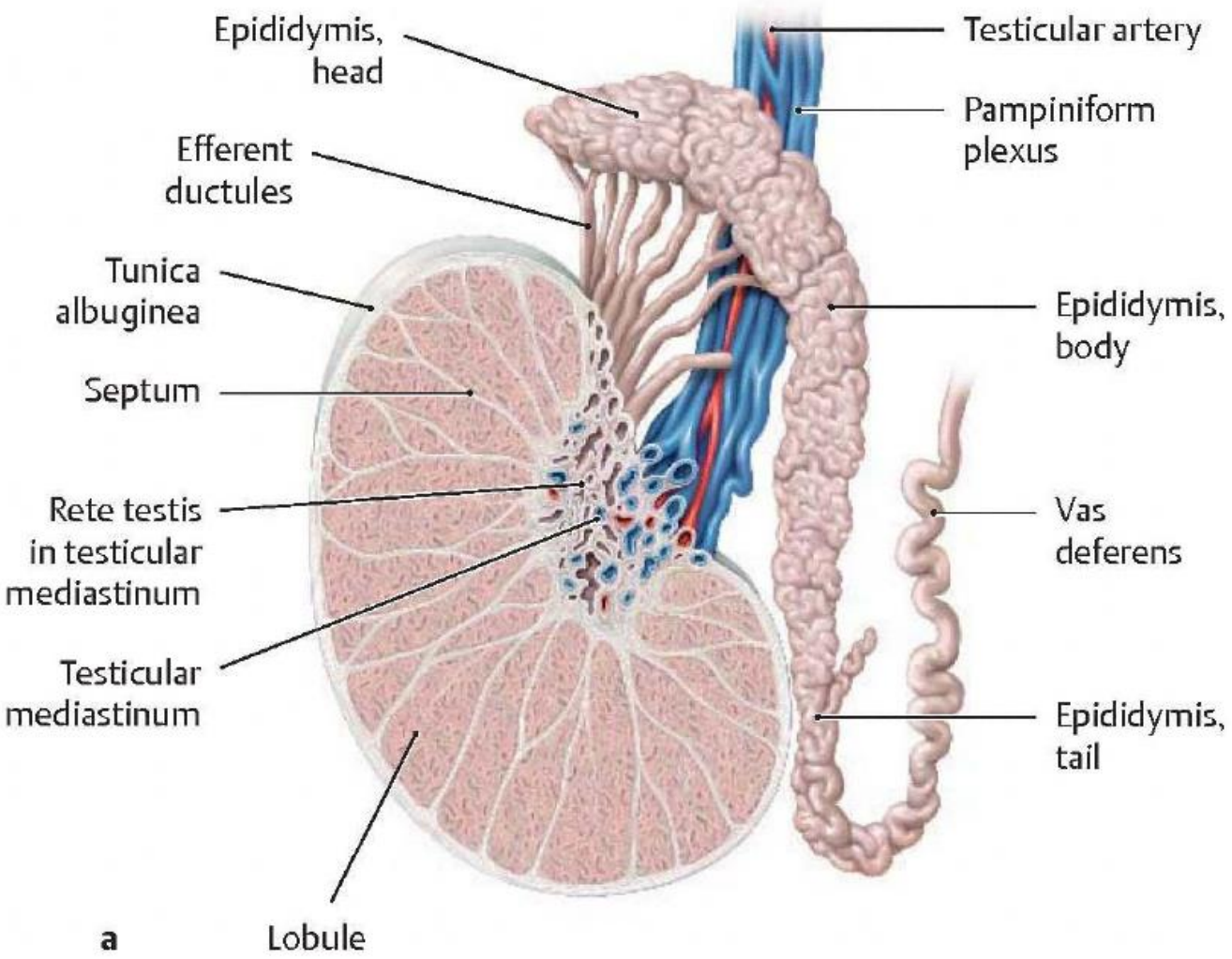
•Parietal lamina (Periorchium)

between: Cavum serosum scroti

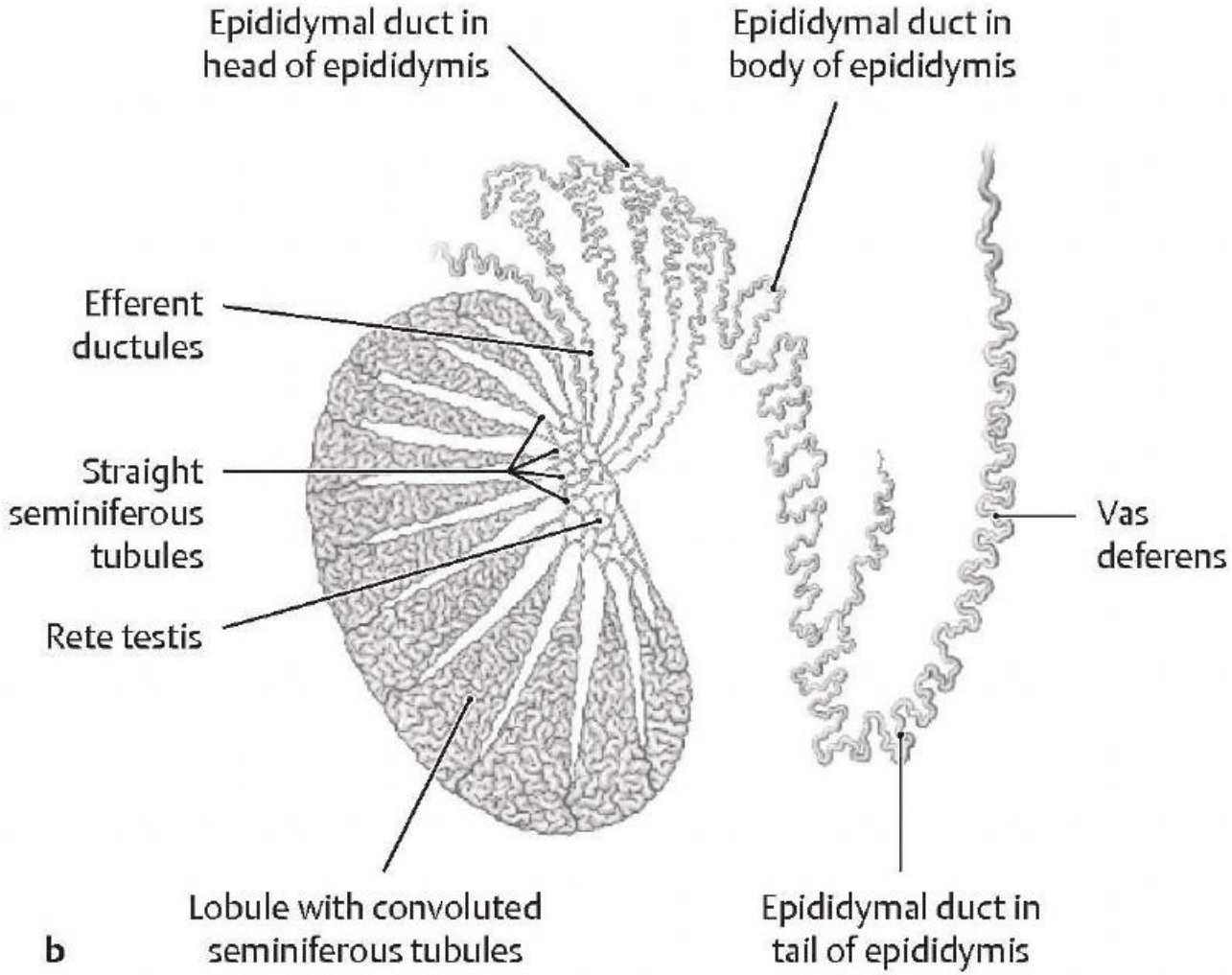
Mesorchium

Appendix testis (hydatid of Morgani) = cranial end of Müllerian duct

STRUCTURES OF THE TESTIS

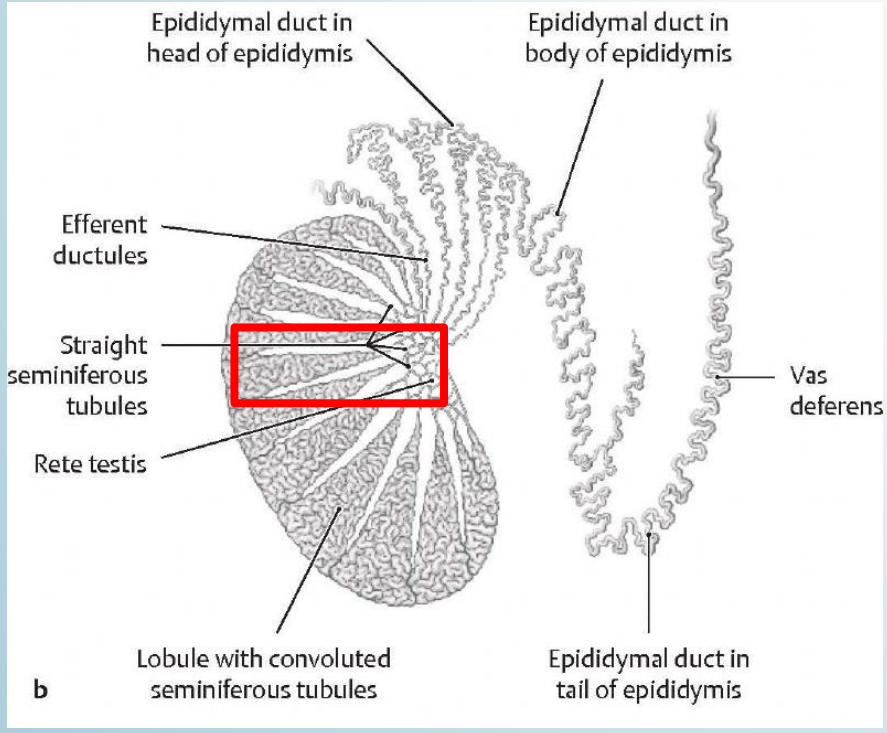


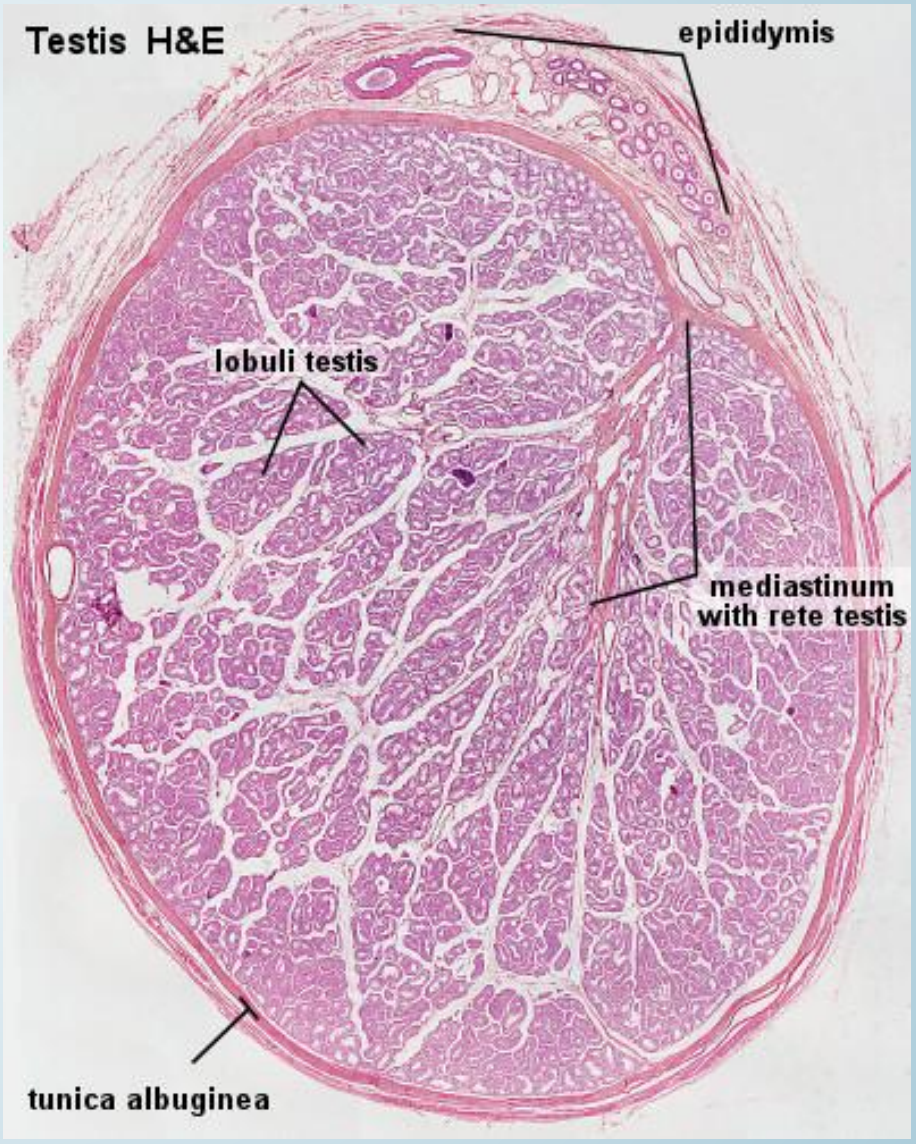
DUCTS OF THE TESTIS



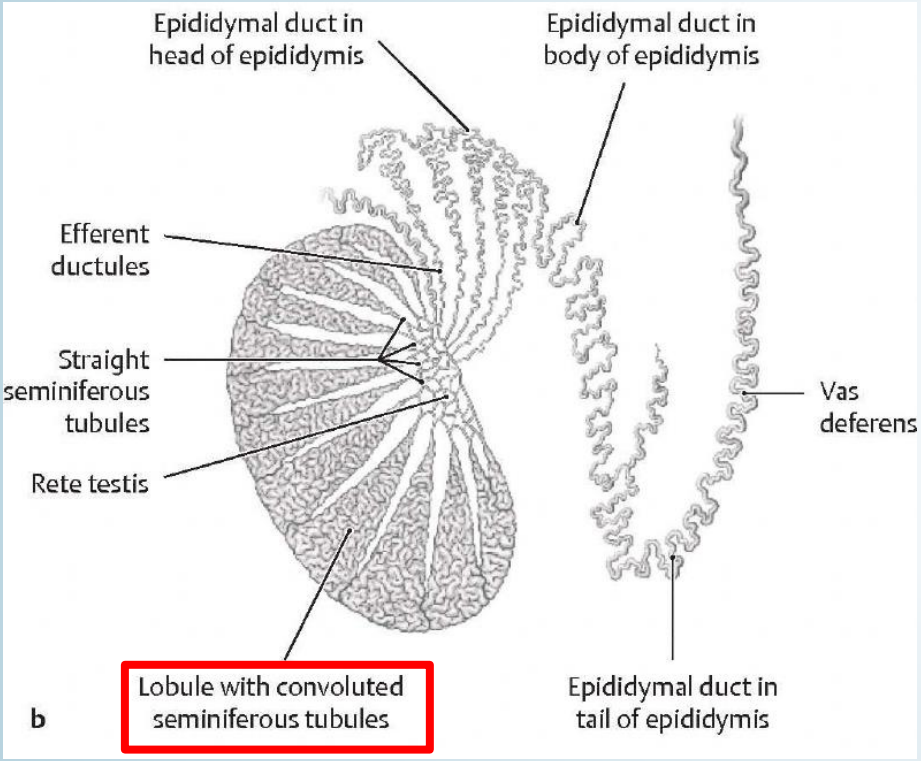
HISTOLOGY OF THE TESTIS

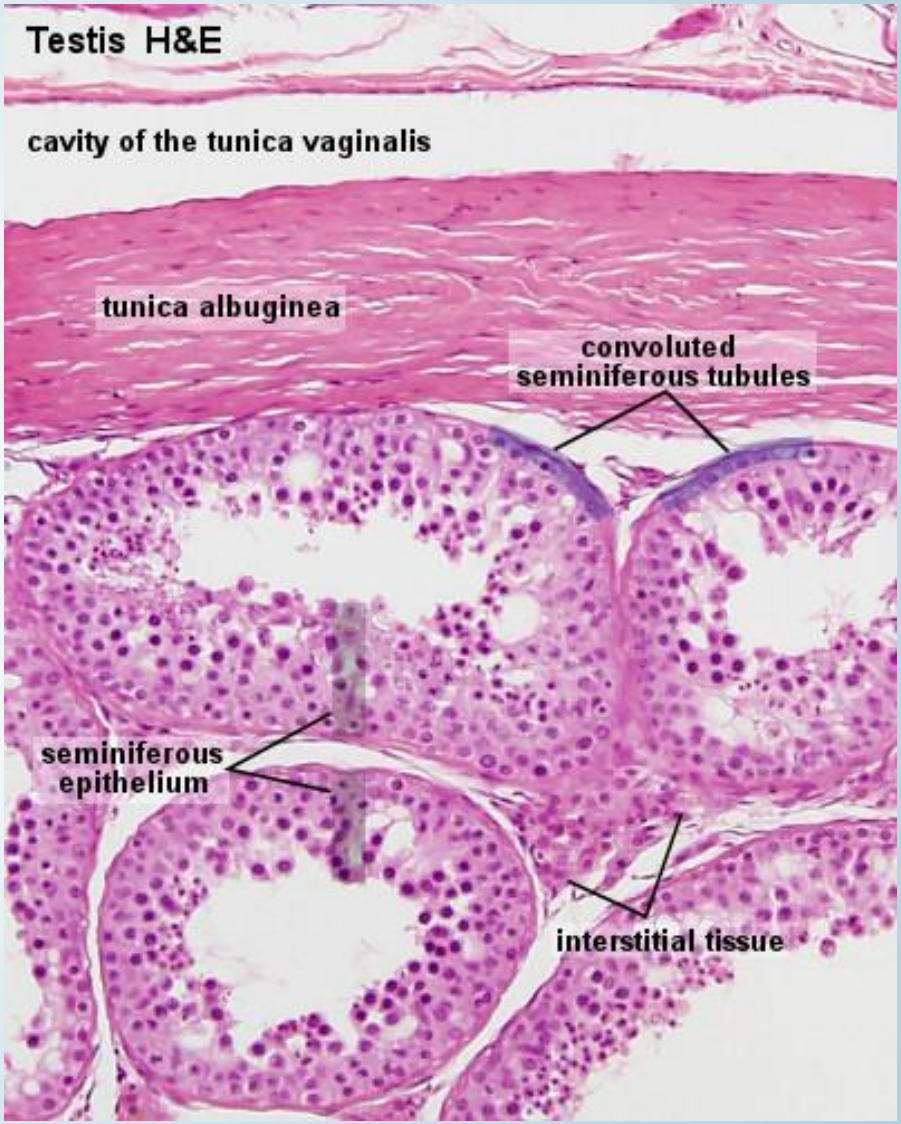
overview



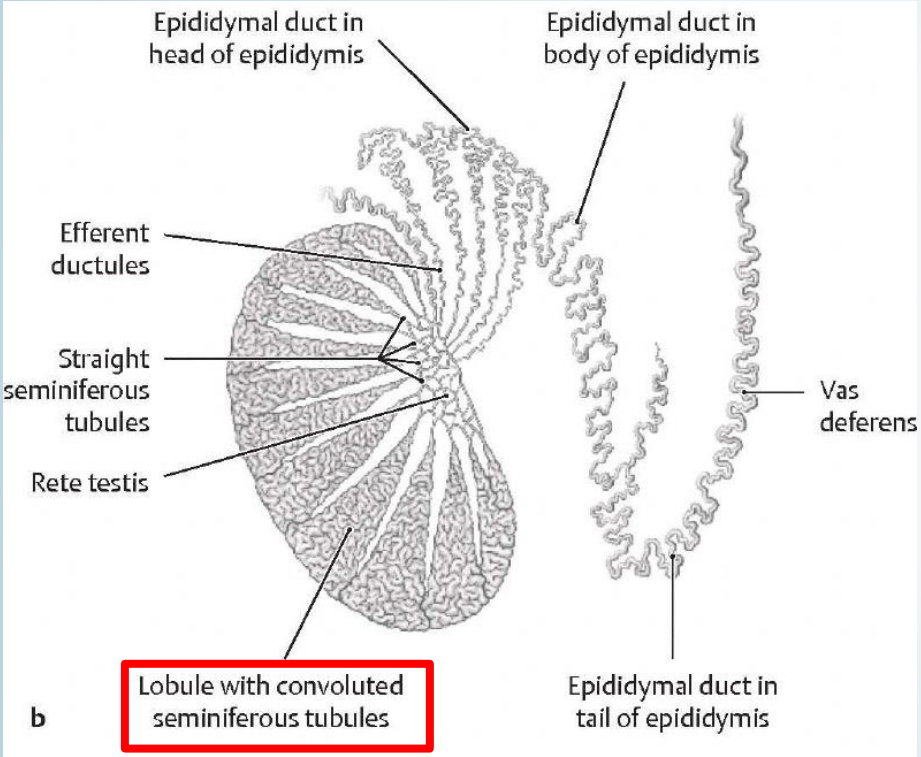


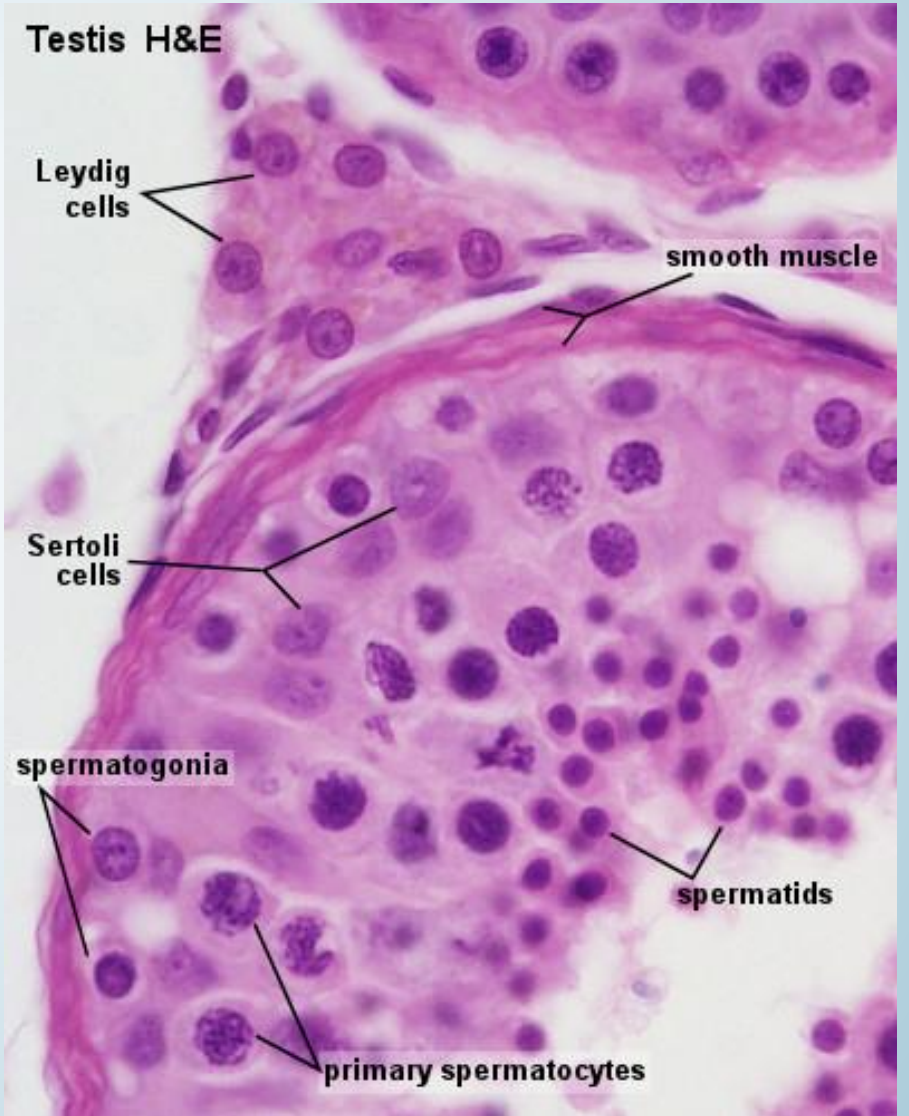
HISTOLOGY OF THE TESTIS



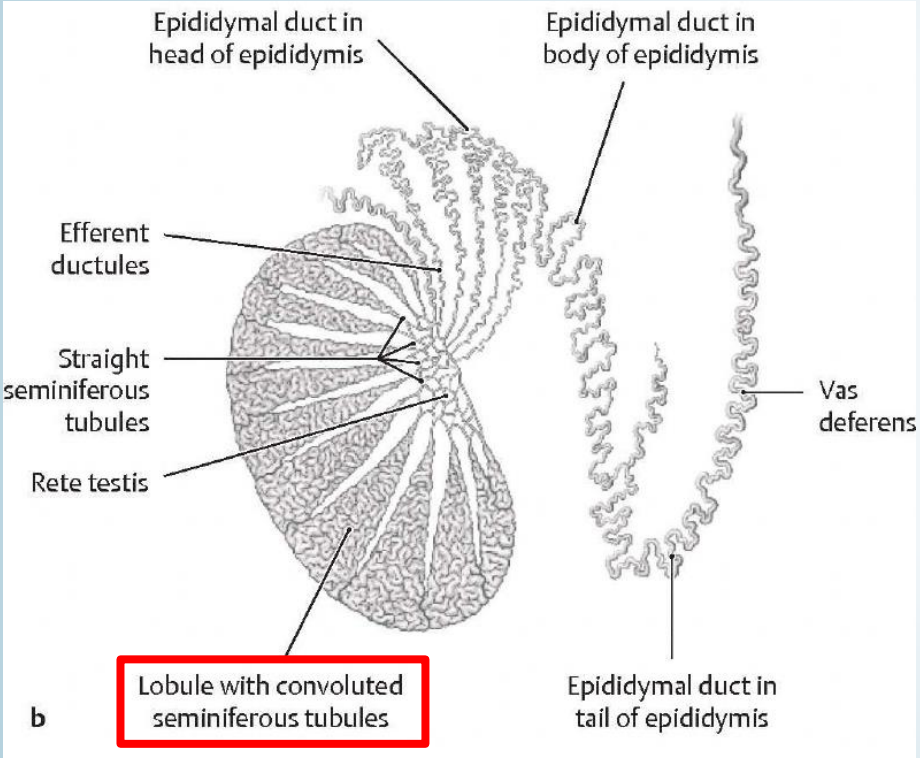


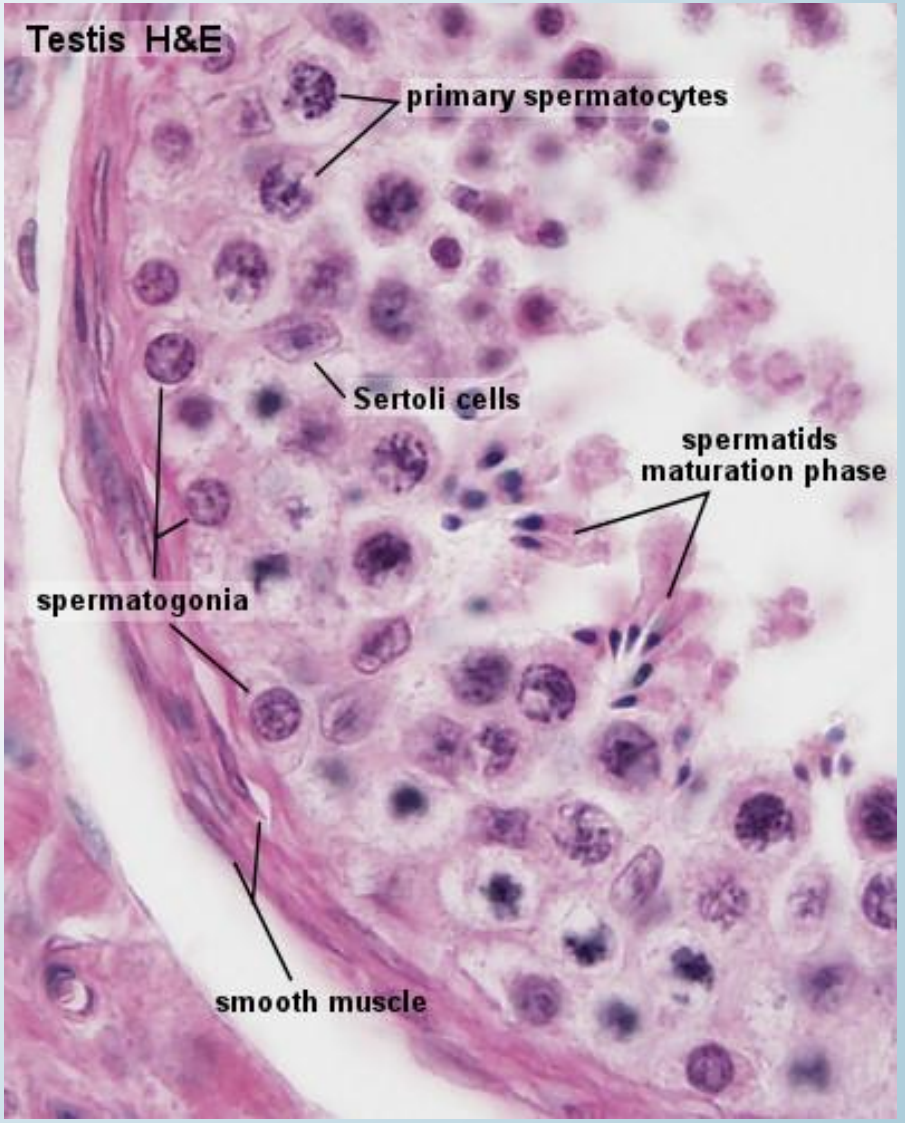
HISTOLOGY OF THE TESTIS





HISTOLOGY OF THE TESTIS



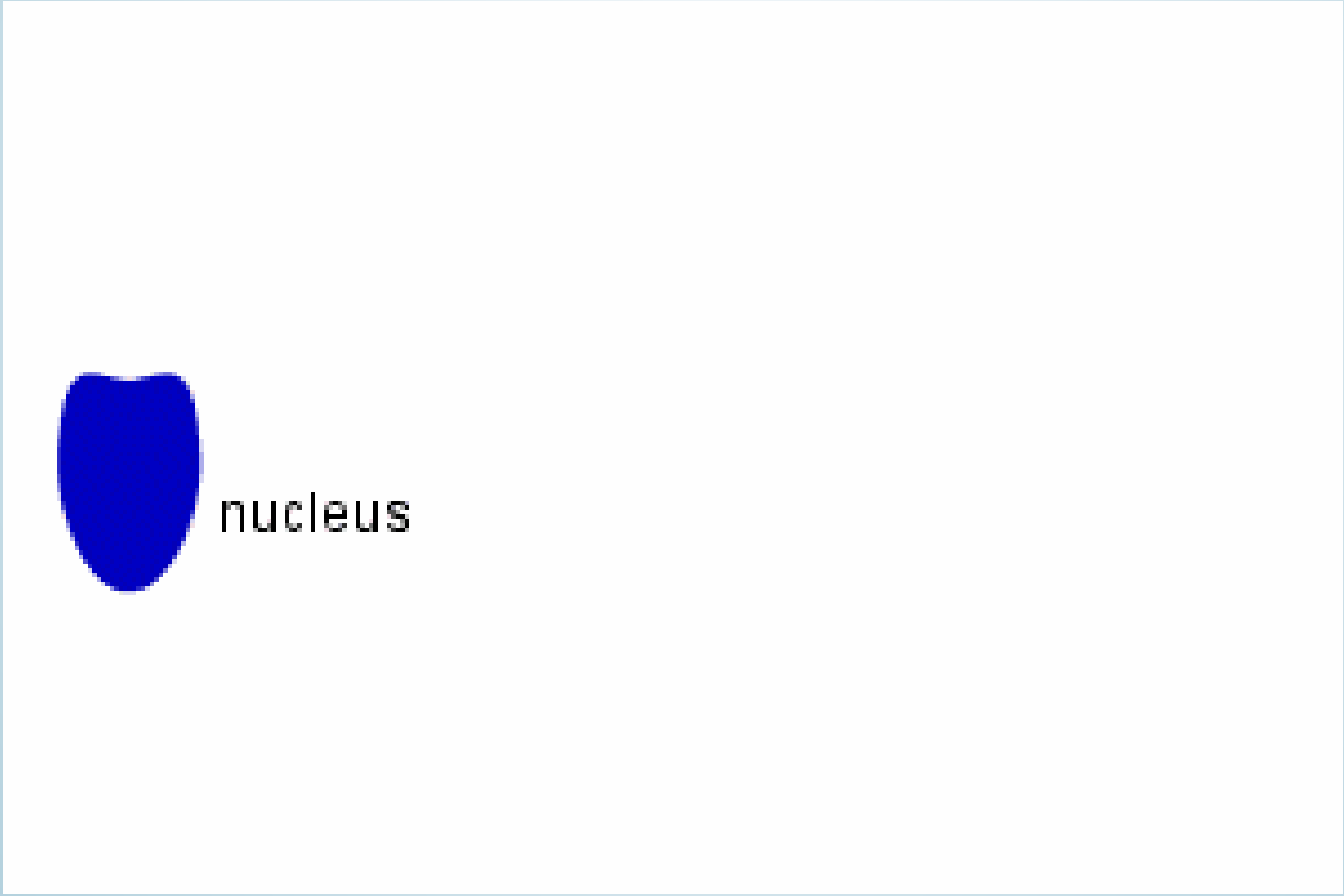


SPERMATOGENESIS

- ***The Convoluted Seminiferous Tubules***
- *These tubules are enclosed by a thick basal lamina and surrounded by 3-4 layers of smooth muscle cells (or myoid cells). The insides of the tubules are lined with seminiferous epithelium, which consists of two general types of cells: spermatogenic cells and Sertoli cells.*
- ***Spermatogenic cells**:*
  Spermatogoniaare the first cells of spermatogenesis. They originate in the 4th week of foetal development in the endodermal walls of the yolk sac and migrate to the primordium of the testis, where they differentiate into spermatogonia. Spermatogonia remain dormant until puberty. They are always in contact with the basal lamina of the tubule.
- *Two types of spermatogonia can be distinguished in the human seminiferous epithelium:*
  Type A spermatogonia have a rounded nucleus with very fine chromatin grains and one or two nucleoli. They are stem cells which divide to form new generations of both type A and type B spermatogonia.
  Type B spermatogonia have rounded nuclei with chromatin granules of variable size, which often attach to the nuclear membrane, and one nucleolus. Although type B spermatogonia may divide repeatedly, they do not function as stem cells and their final mitosis always results in the formation of
- *Primary spermatocytes which lie in the cell layer luminal to the spermatogonia. They appear larger than spermatogonia. They immediately enter the prophase of the first meiotic division, which is extremely prolonged (about 22 days!). A large number of primary spermatocytes is always visible in cross-sections through seminiferous tubules. Cell divisions, from the formation of primary spermatocytes and onwards, to the production of the spermatocytes, are incomplete. The cells remain connected by bridges of cytoplasm. The completion of the first meiotic division results in the formation of*
- *Secondary spermatocytes which are smaller than primary spermatocytes. They rapidly enter and complete the second meiotic division and are therefore seldom seen in histological preparations. Their division results in the formation of*
- *Spermatids, which lie in the luminal part of the seminiferous epithelium. They are small (about 10 μm in diameter) with an initially very light (often eccentric) nucleus. The chromatin condenses during the maturation of the spermatids into spermatozoa, and the nucleus becomes smaller and stains darker.*

SPERMIOGENESIS

The terminal phase of spermatogenesis is called spermiogenesis and consists of the differentiation of the newly formed spermatids into spermatozoa



SPERMIOGENESIS

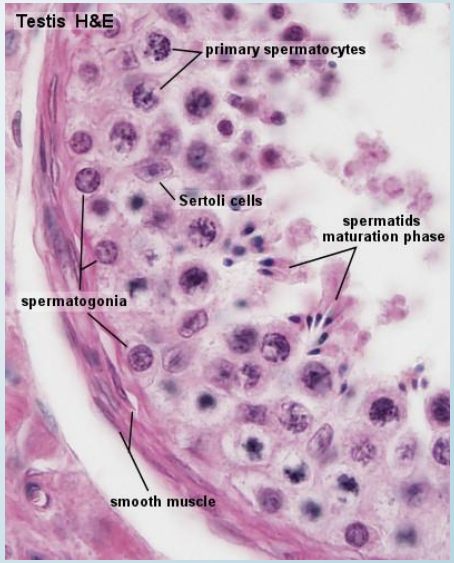
- *The mature human spermatozoon is about 60 μm long and actively motile. It is divided into head, neck and tail.*
- *The head (flattened, about 5 μm long and 3 μm wide) chiefly consists of the nucleus (greatly condensed chromatin!). The anterior 2/3 of the nucleus is covered by the acrosome, which contains enzymes important in the process of fertilisation. The posterior parts of the nuclear membrane forms the so-called basal plate.*
- *The neck is short (about 1 μm) and attached to the basal plate. A transversely oriented centriole is located immediately behind the basal plate. The neck also contains nine segmented columns of fibrous material, which continue as the outer dense fibres into the tail.*

- *The tail is further divided into a middle piece, a principal piece and an end piece. The axonema (the generic name for the arrangement of microtubules in all cilia) begins in the middle piece. It is surrounded by nine outer dense fibres, which are not found in other cilia. In the middle piece (about 5 μm long), the axonema and dense fibres are surrounded by a sheath of mitochondria. The middle piece is terminated by a dense ring, the annulus. The principal piece is about 45 μm long. It contains a fibrous sheath, which consists of dorsal and ventral longitudinal columns interconnected by regularly spaced circumferential hoops. The fibrous sheath and the dense fibres do not extend to the tip of the tail. Along the last part (5 μm) of the tail, called the end piece, the axonema is only surrounded by a small amount of cytoplasm and the plasma membrane.*

SERTOLI CELLS

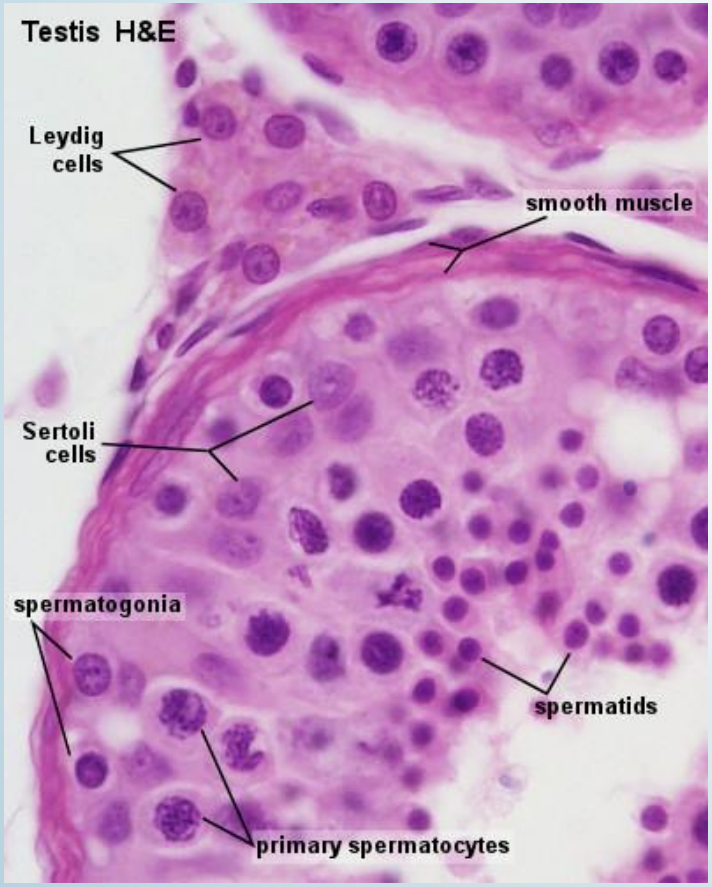
are far less numerous than the spermatogenic cells and are evenly distributed between them. Their shape is highly irregular - columnar is the best approximation. Sertoli cells extend from the basement membrane to the luminal surface of the seminiferous epithelium. Processes of the Sertoli cells extend in between the spermatogenic cells(cell limits are therefore not clearly visible in the LM). The nucleus of Sertoli cells is ovoid or angular, large and lightly stained and often contains a large nucleolus. The long axis of the nucleus is oriented perpendicular to wall of the tubule. A fold in the nuclear membrane is characteristic for Sertoli cells but not always visible in the LM (well ... actually ... it's not that difficult to find, but not that easy either ....).

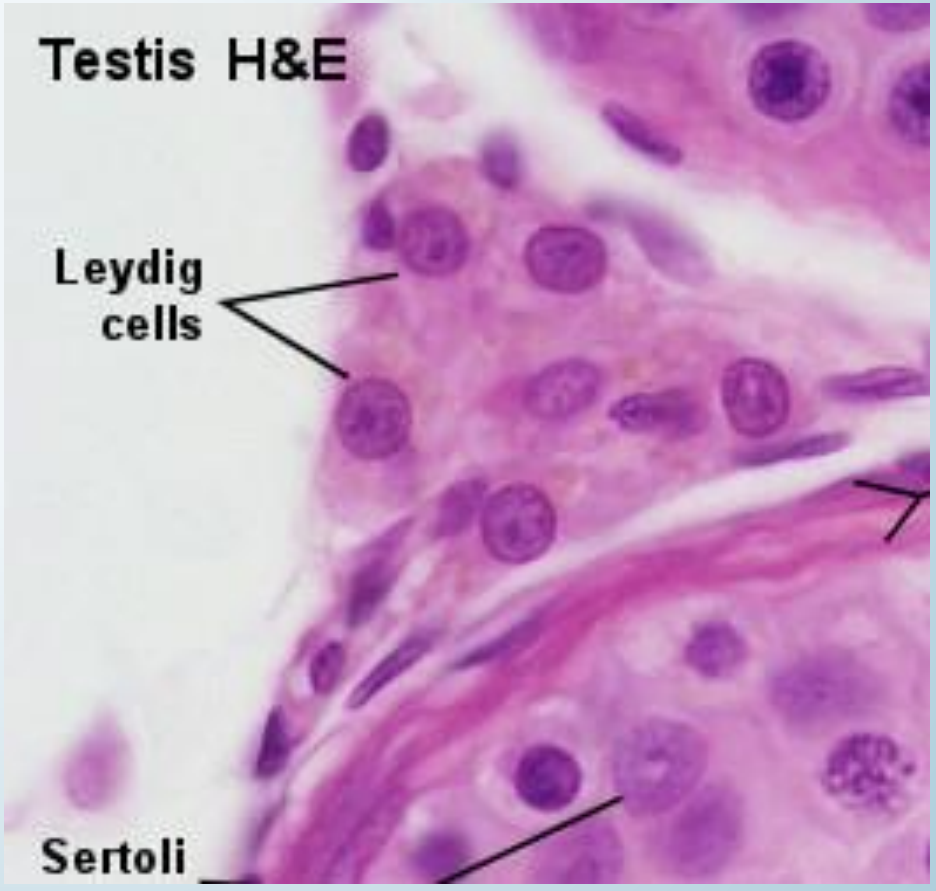
Lateral processes of Sertoli cells are interconnected by tight junctions, which are likely to be the structural basis for the blood-testis barrier. Spermatogonia and primary spermatocytes are located in the basal compartment, other cellular stages of spermatogenesis are located in the adluminal compartment. Tight junctions may temporarily open to permit the passage of spermatogenic cells from the basal into the adluminal compartment. Sertoli cells provide mechanical and nutritive support for the spermatogenic cells. Sertoli cells also secrete two hormones - inhibin and activin - which provide positive and negative feedback on FSH secretion from the pituitary.



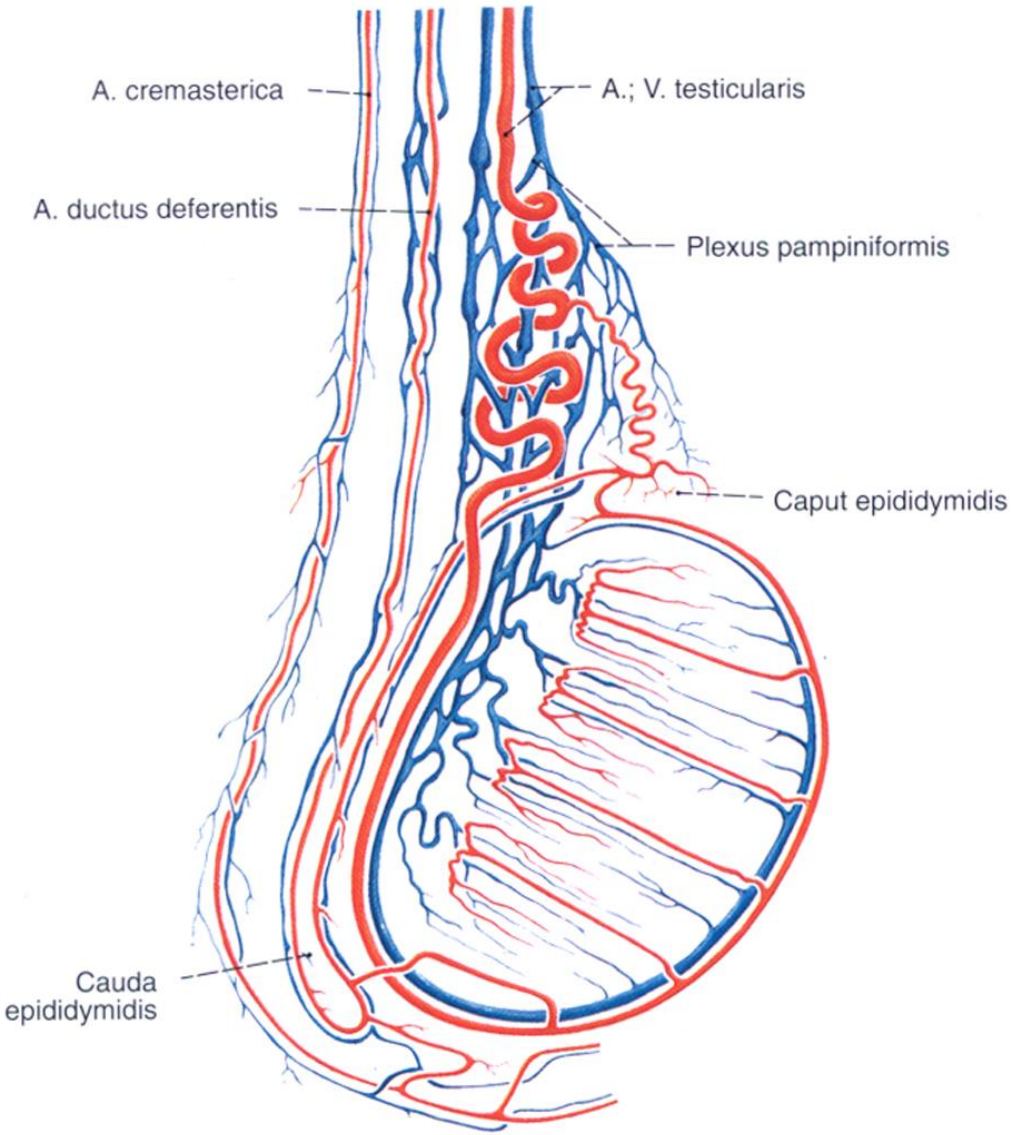
LEYDIG CELLS

Leydig cells (15-20 μm), located in the interstitial tissue between the convoluted seminiferous tubules, constitute the endocrine component of the testis. They synthesise and secrete testosterone. Ledig cells occur in clusters , which are variable in size and richly supplied by capillaries. The cytoplasm is strongly acidophilic and finely granular. The nucleus is large, round and often located eccentric in the cell.





BLOOD SUPPLY



Testicular a.:

From the Aorta (L1-2)

Anastomosis with:

Vas deferes a.

Cremasteric a.

Inf. Epigastric a.

Veins:

Pampiniform plexus → Testicular v.

left: Renal v.

right: inf. V. cava

Lymphatic vessels:

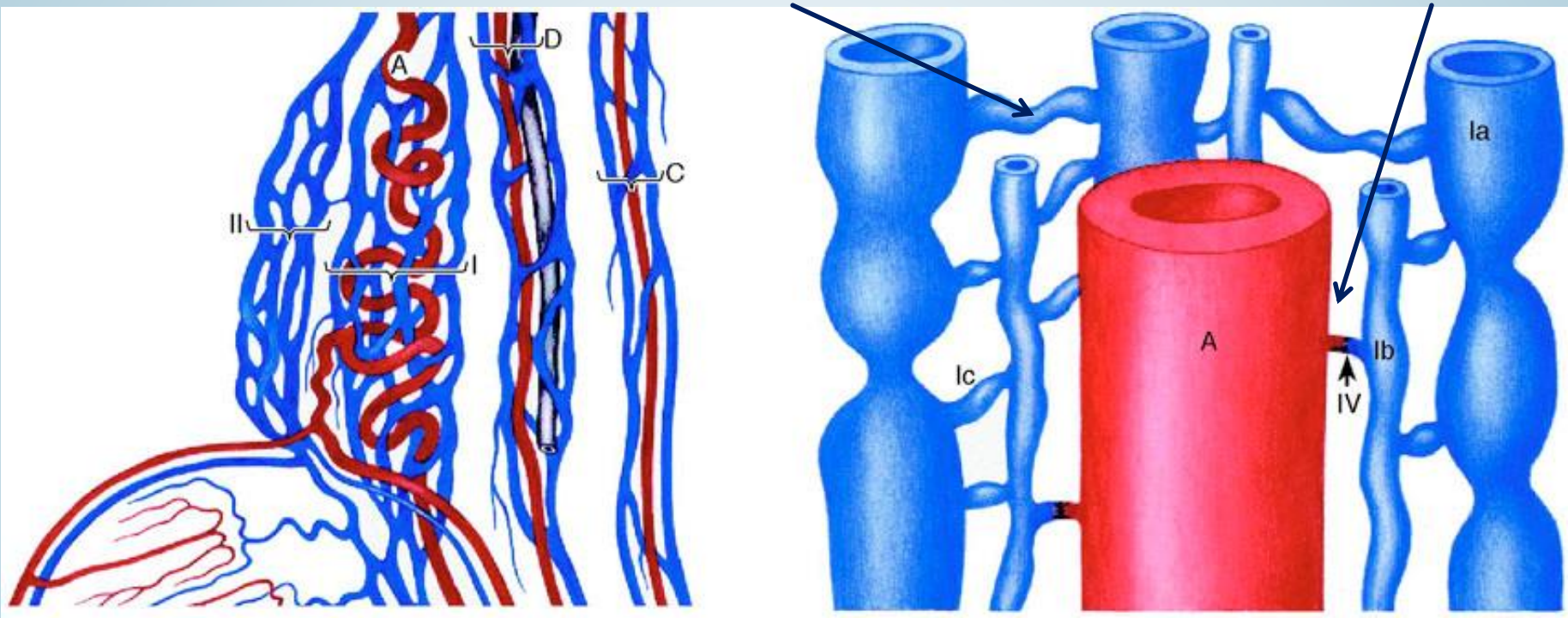
testis: lumbal lymph nodes

scrotum, coats: inguinal lymph nodes

TESTICULAR CIRCULATION

Anastomosis between veins

Arteriovenosal anastomosis



Venous plexuses around the:
- Testicular a.
- Vas deferens a.
- Cremasteric a.

Independent venous plexuses

Muscular veins! → constrictions, regulation of circulation

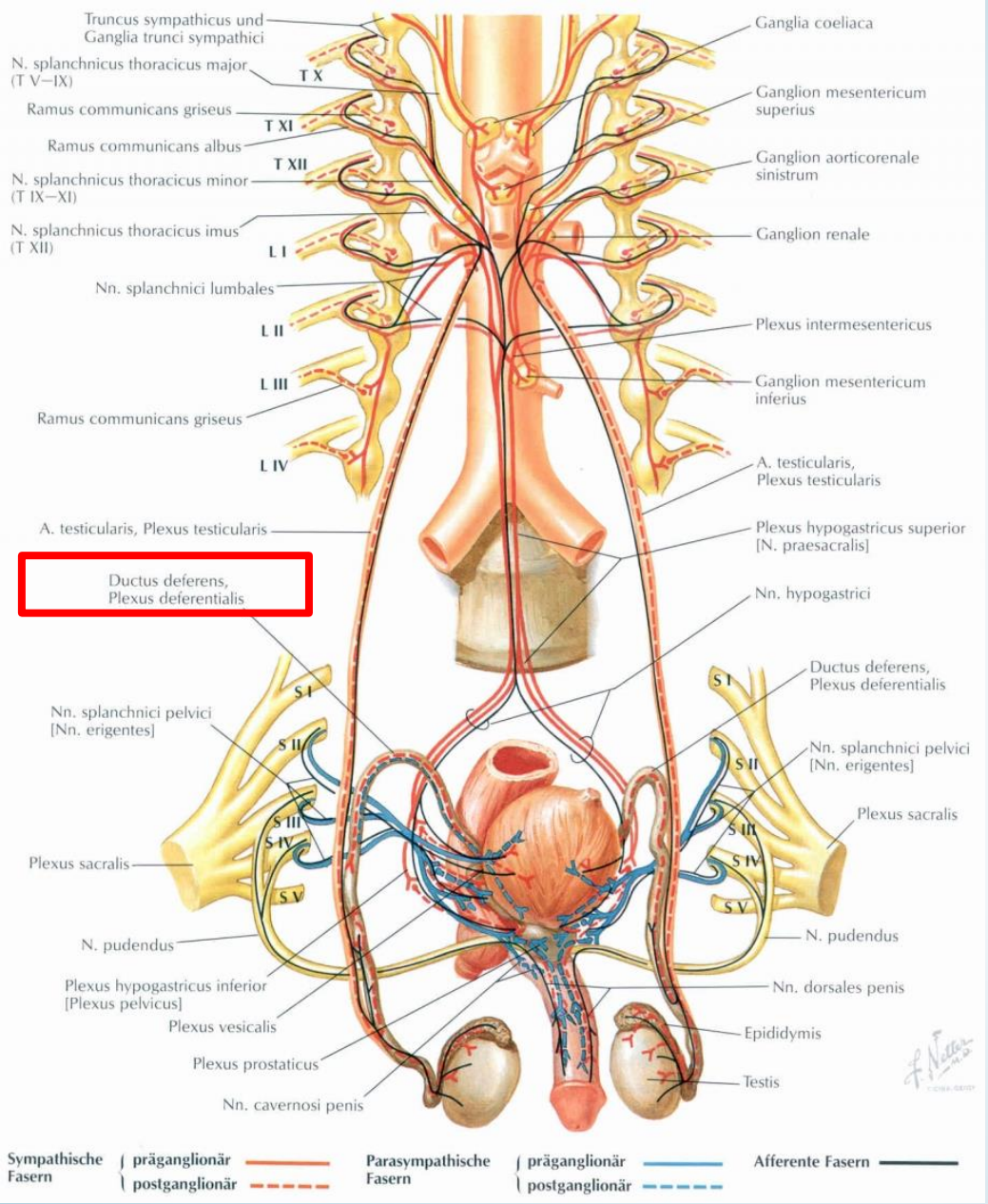
Arteriovenosal anastomosis:

Testosterone-rich blood enters the testicles back → Higher testosterone levels in testicular artery as peripheral, testicular testosterone cycle near

INNERVATION OF THE SCROTUM

Nerve	*Surface*
• *Genital branch of genitofemoral nerve*	*anterolateral*
• *Anterior scrotal nerves (from ilioinguinal nerve)*	*anterior*
• *Posterior scrotal nerves (from perineal nerve)*	*posterior*
• *perineal branches of posterior femoral cutaneous nerve*	*inferior*

INERVATION OF THE TESTICLES



Testicular plexus:

Sympathic branches from the

coeliac pl.

intermesenteric pl.

renalis pl.

Innervation of the

Vessels

Leydig-cells

smooth m.; T. albuginea

Parasympathetic fibers from:

Vagus?

TORSION OF THE TESTICLES

human

Dog (left: normal testis)