

Morphology and histology of the testicle. Spermiogenesis.

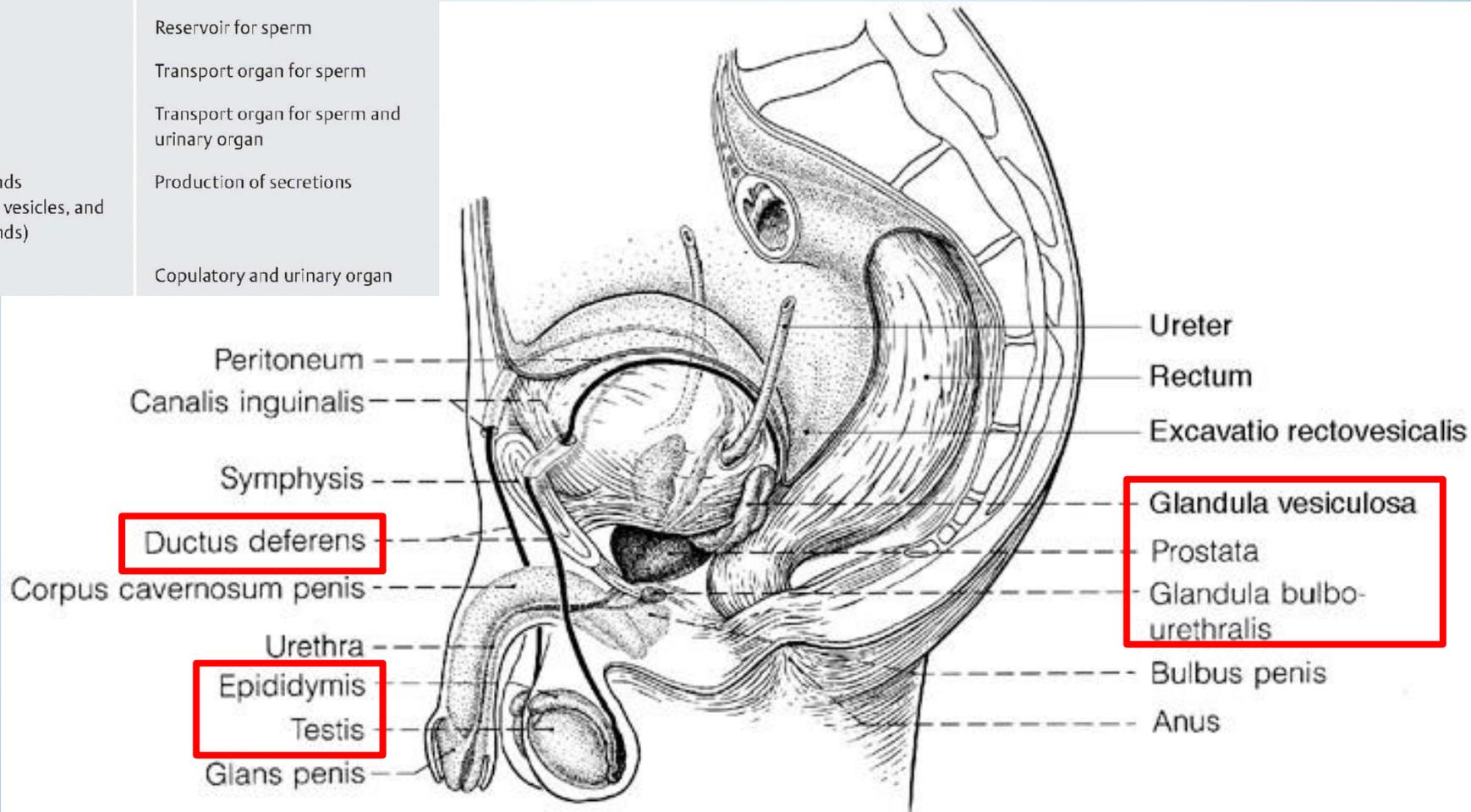


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OVERVIEW OF THE MALE GENITAL TRACT

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

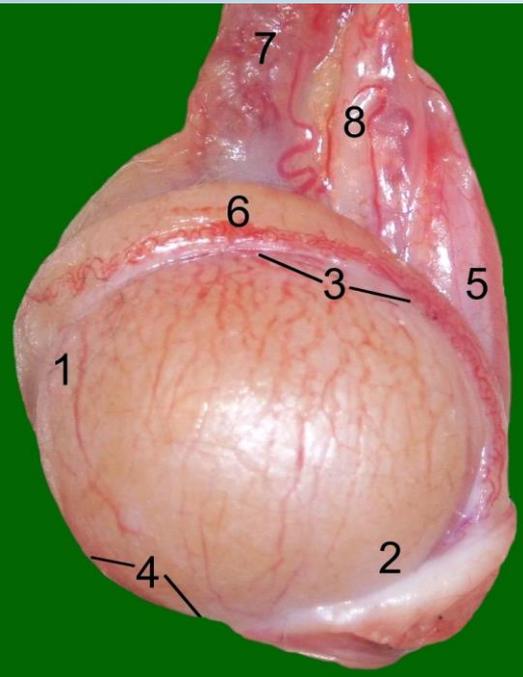


TESTICLES - FUNCTIONS

- *Germ-cell production (Convolutated semiferous tubules):*
 - Spermiogenesis*
 - Spermiohistogenesis*
- *Testosterone 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
- 45° 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

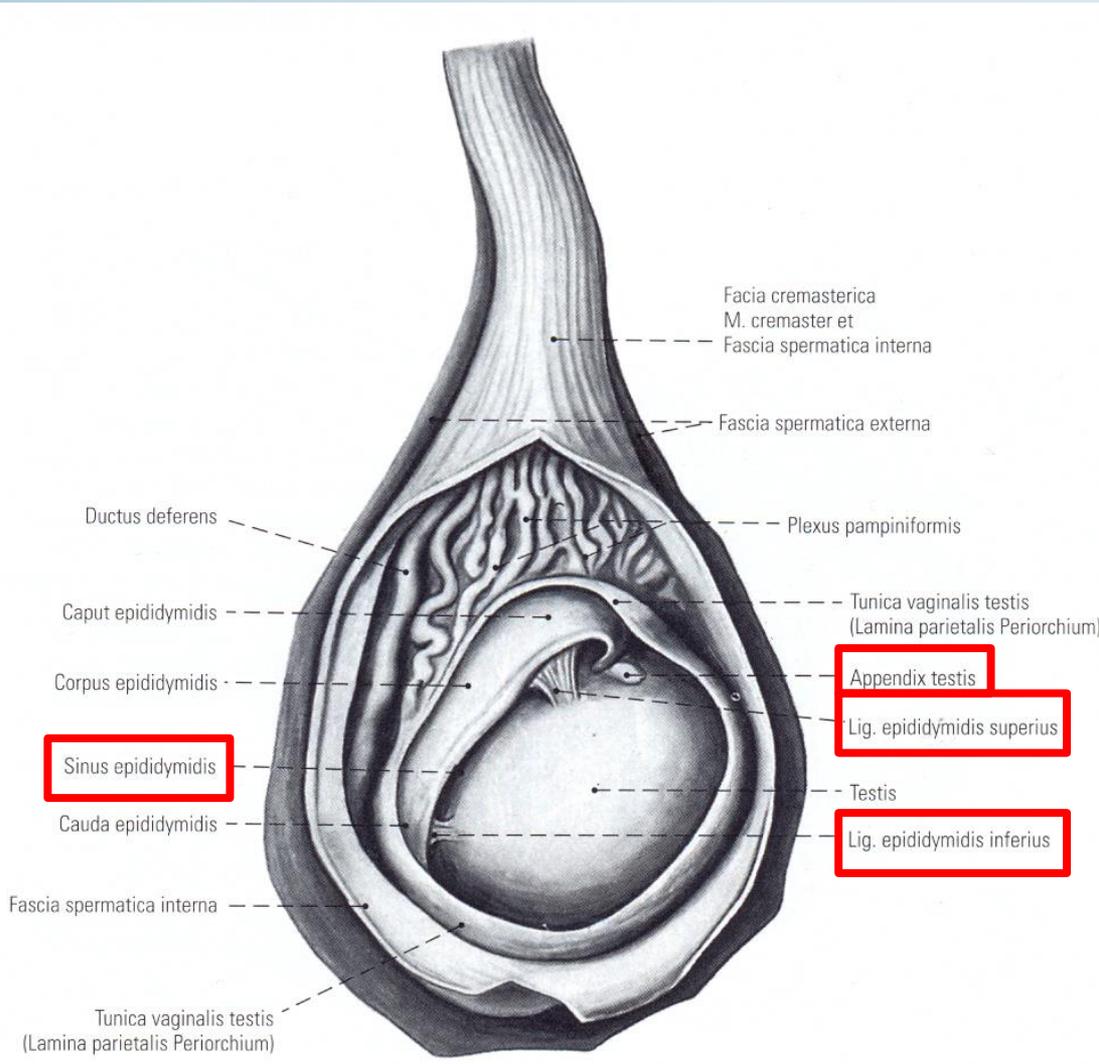
Testis

Weight	ca. 20 g
Length	ca. 4 cm
Width	ca. 2 cm
350–370 testicular lobules	
Approximately 12 efferent ductules	

Epididymis

Length of epididymal duct	
– Uncoiled	ca. 6 m
– Coiled	ca. 6 cm

TESTICLE - STRUCTURES



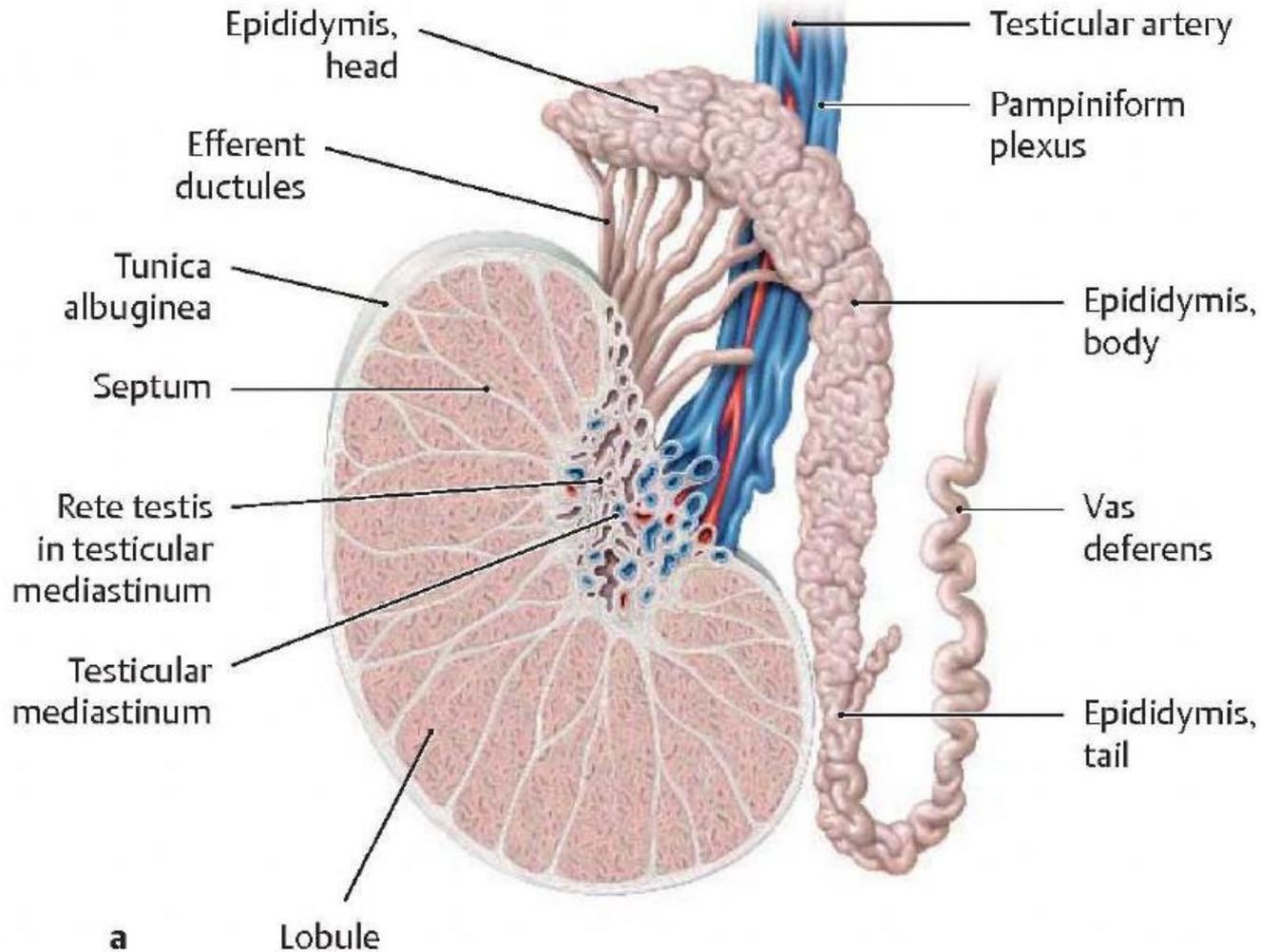
Tunica vaginalis testis =

- Visceral lamina (Epiorchium)
- Parietal lamina (Periorchium)

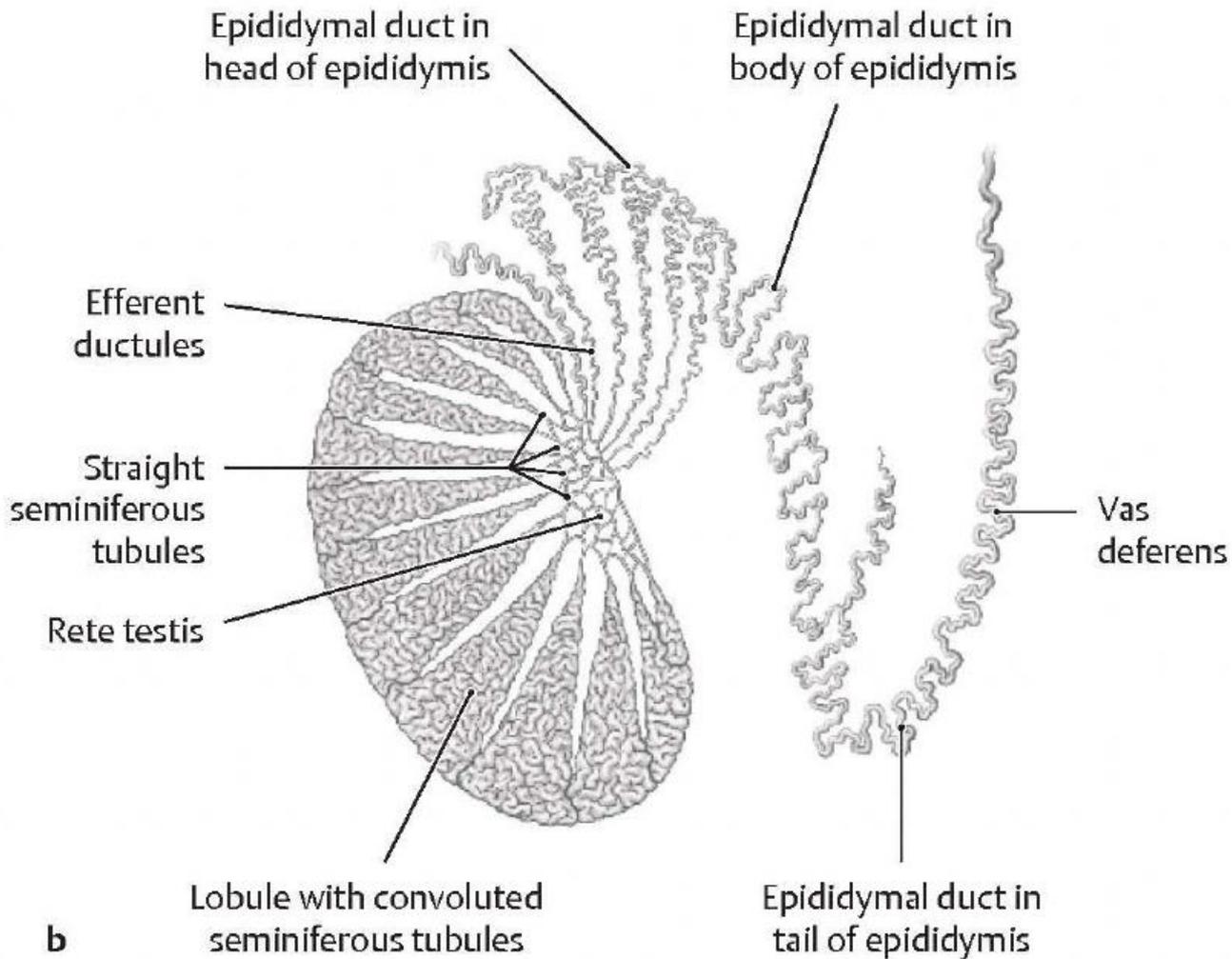
between: Cavum serosum scroti
Mesorchium

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

STRUCTURES OF THE TESTIS AND EPIDIDYMIS

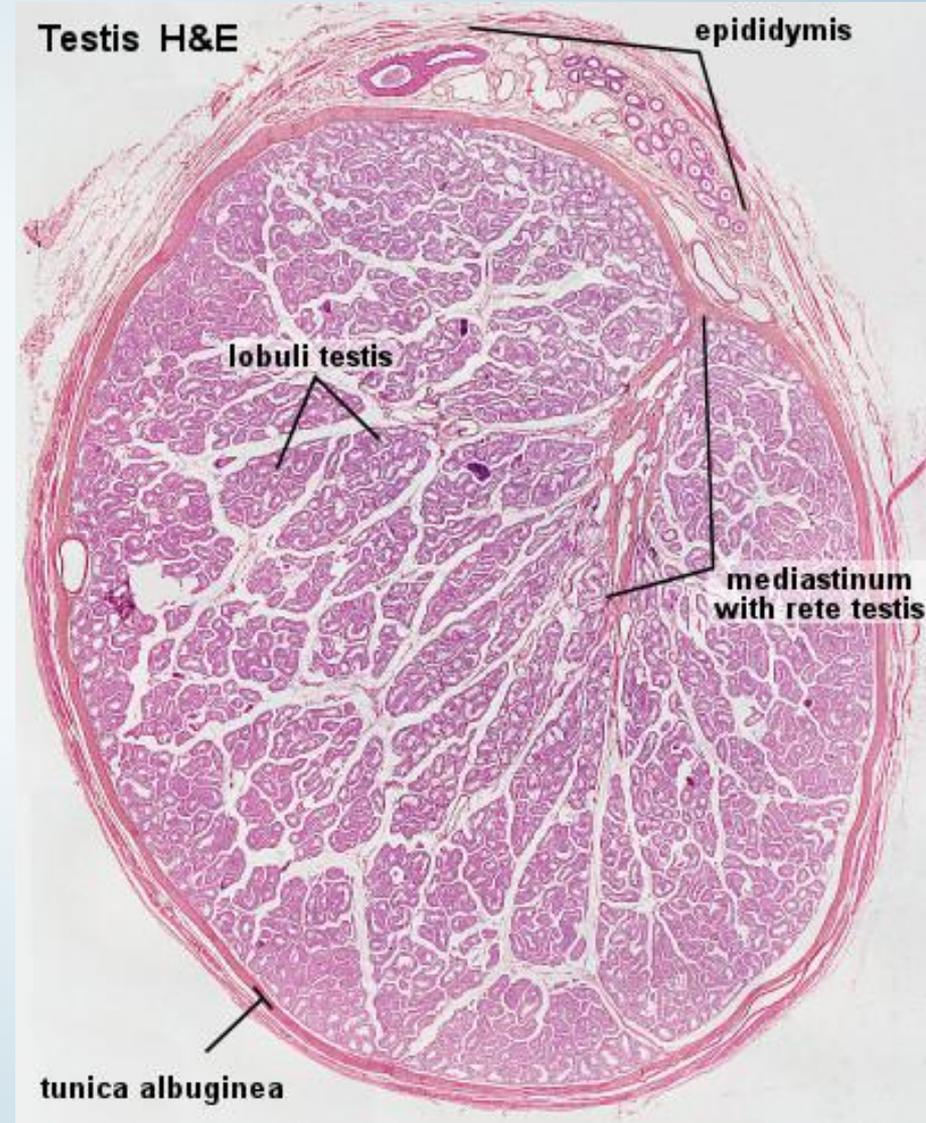
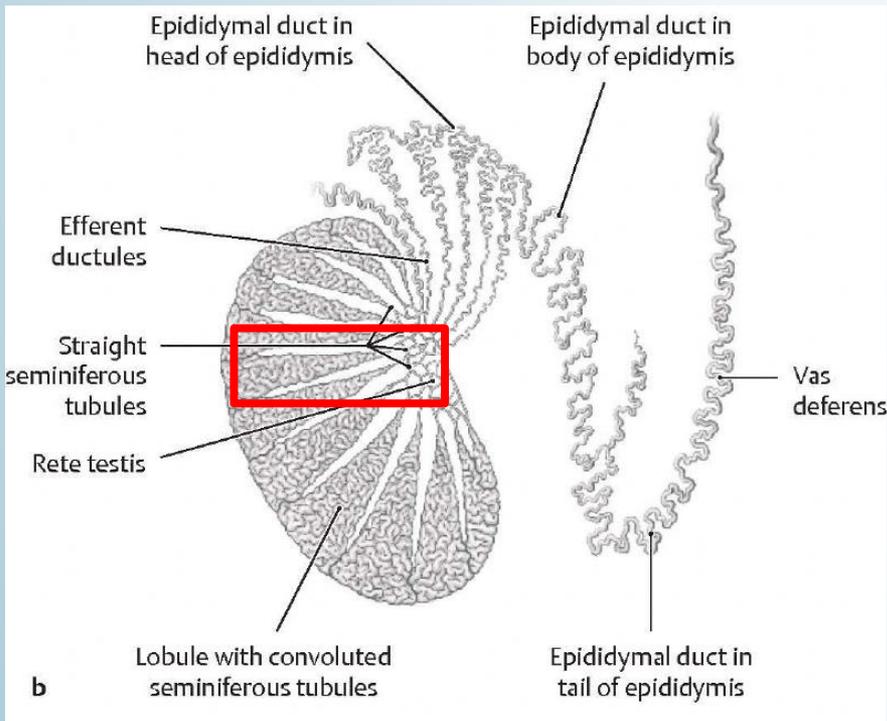


DUCTS OF THE TESTIS AND EPIDIDYMIS

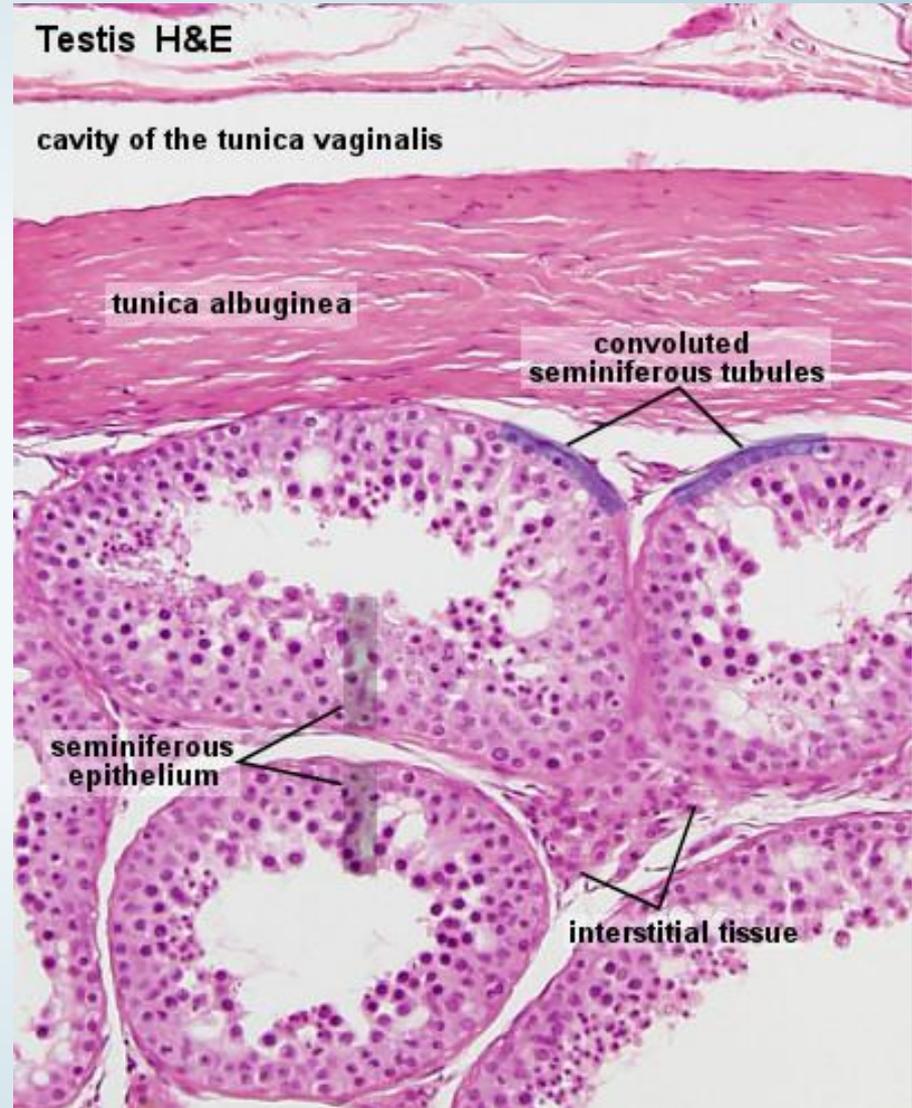
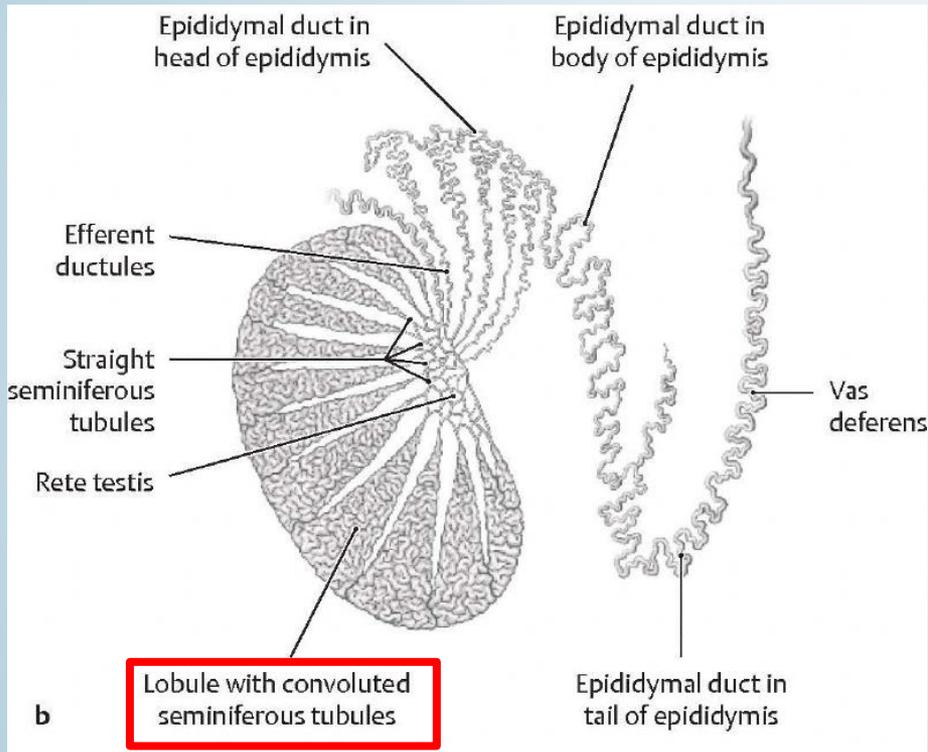


HISTOLOGY OF THE TESTIS AND EPIDIDYMIS

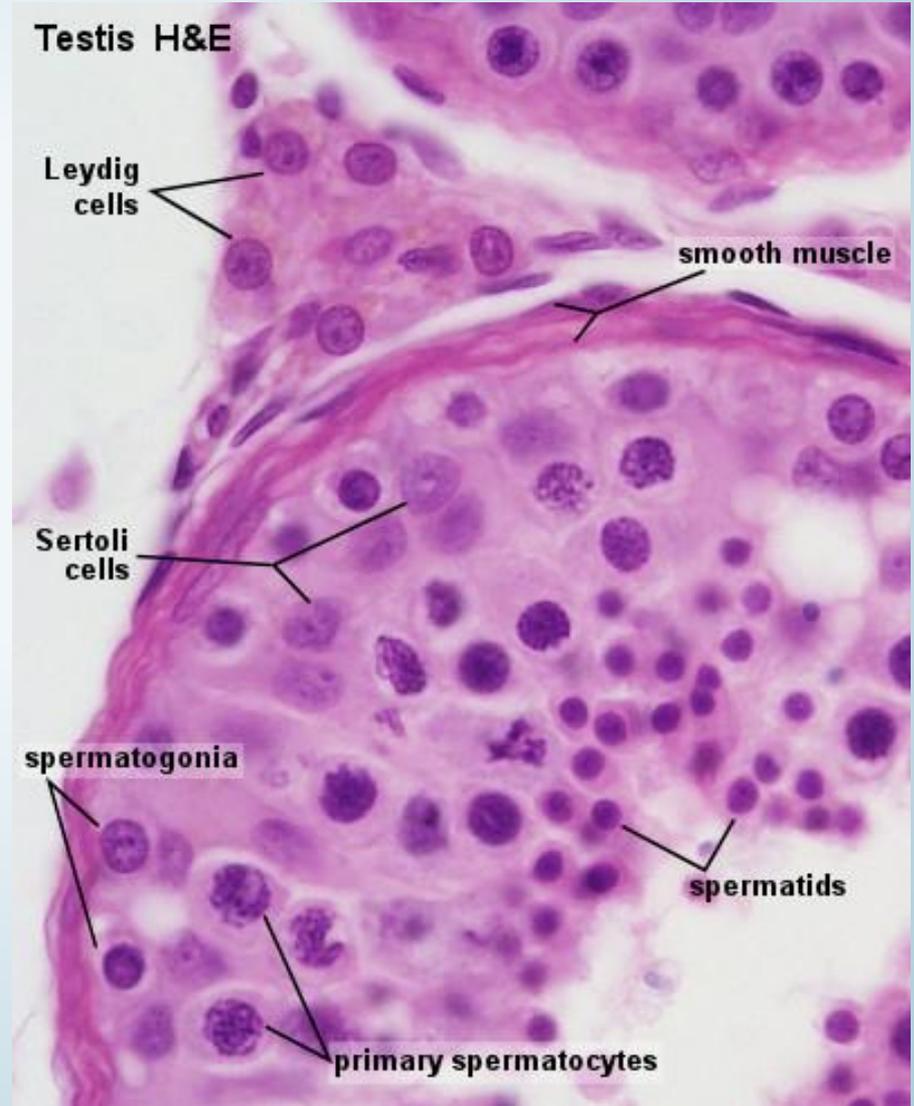
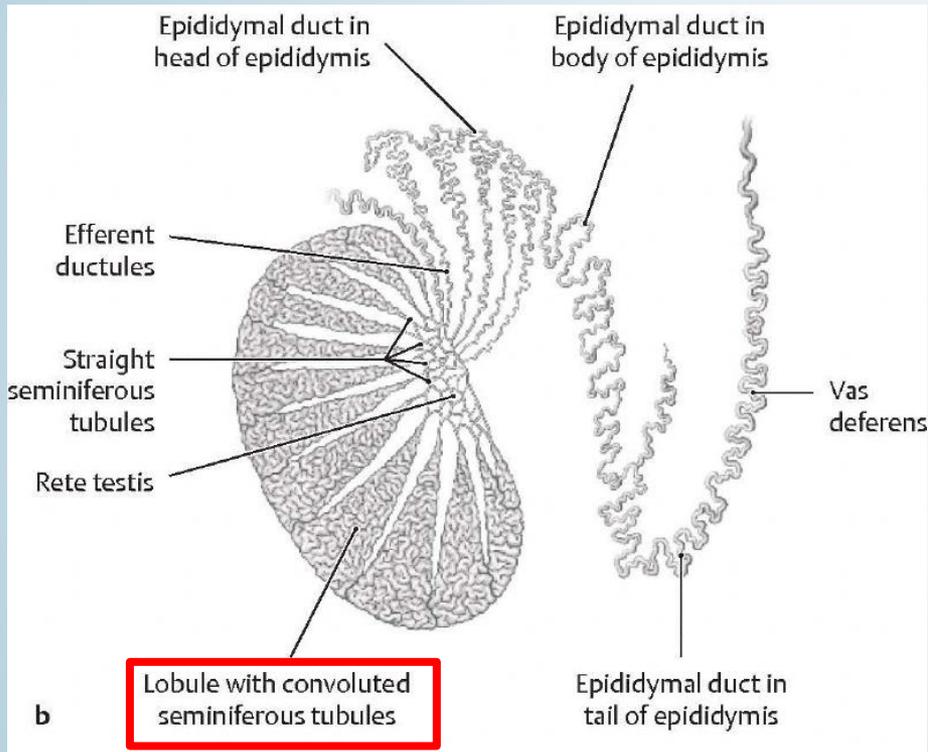
overview



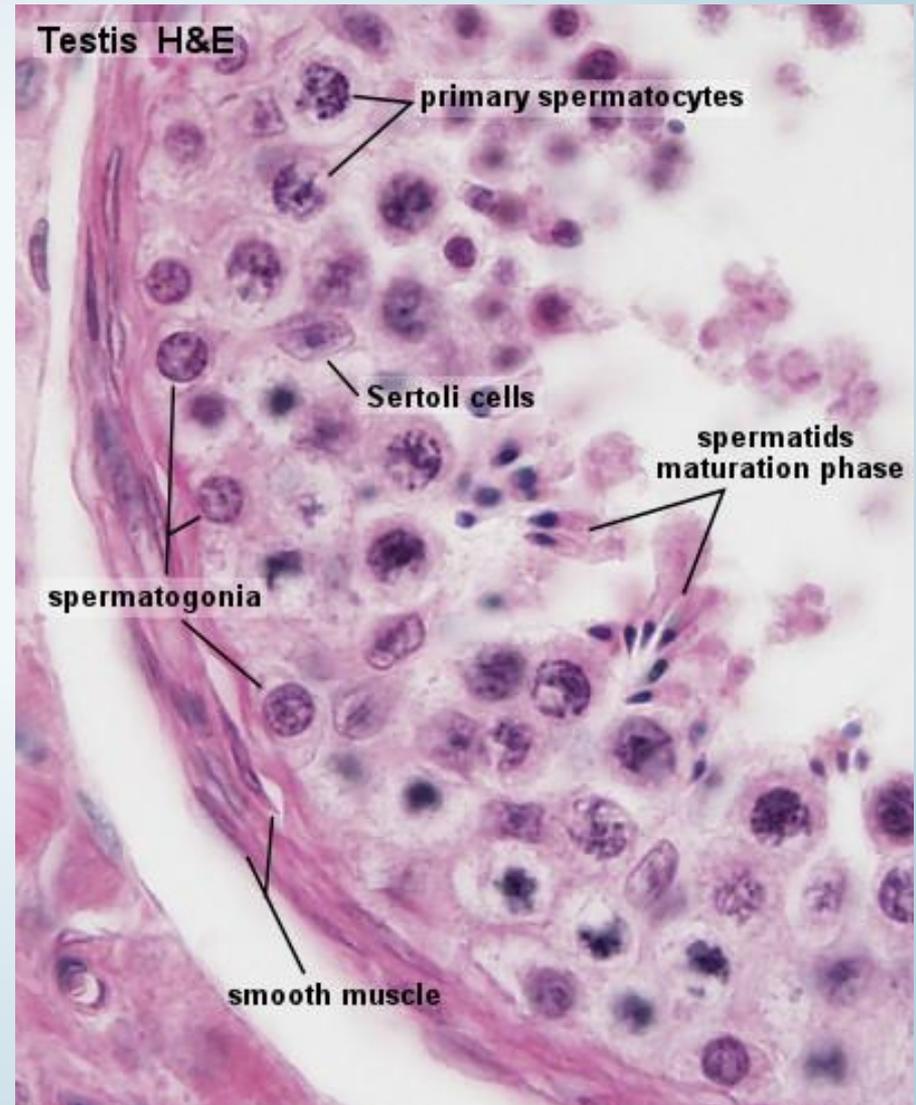
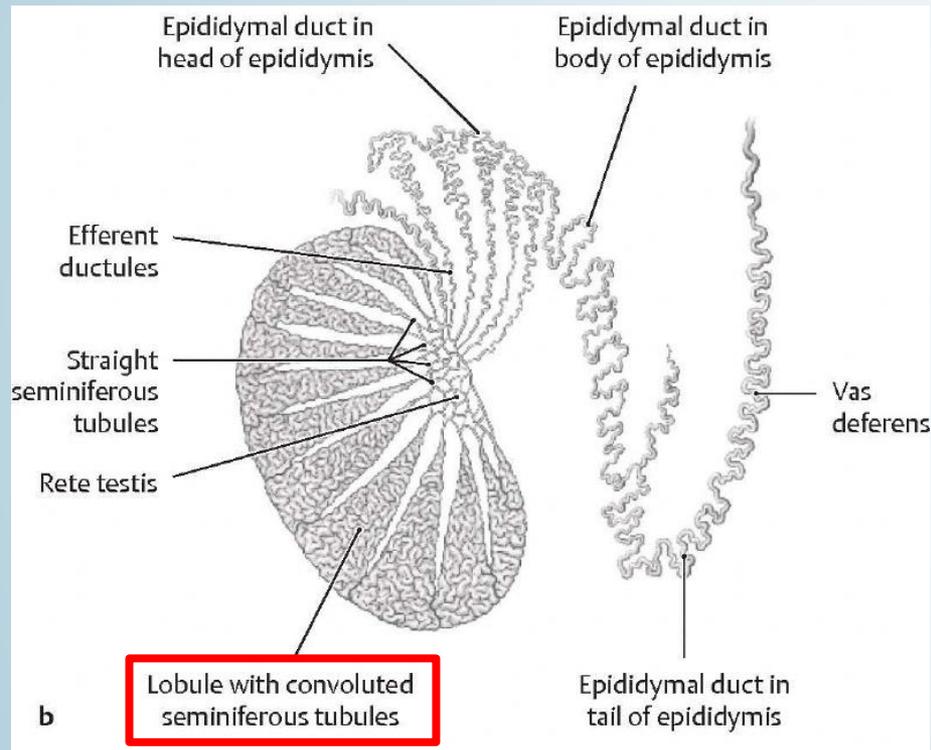
HISTOLOGY OF THE TESTIS AND EPIDIDYMIS



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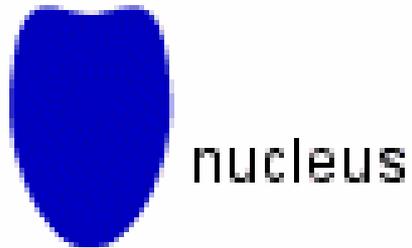


SPERMATOGENESIS

- ***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:***
Spermatogonia are 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



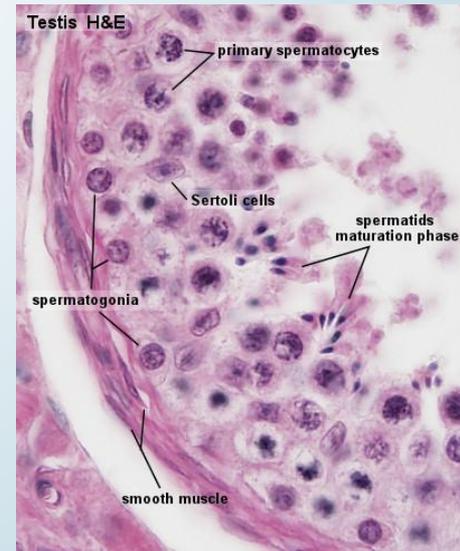
SPERMIOGENESIS

- *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

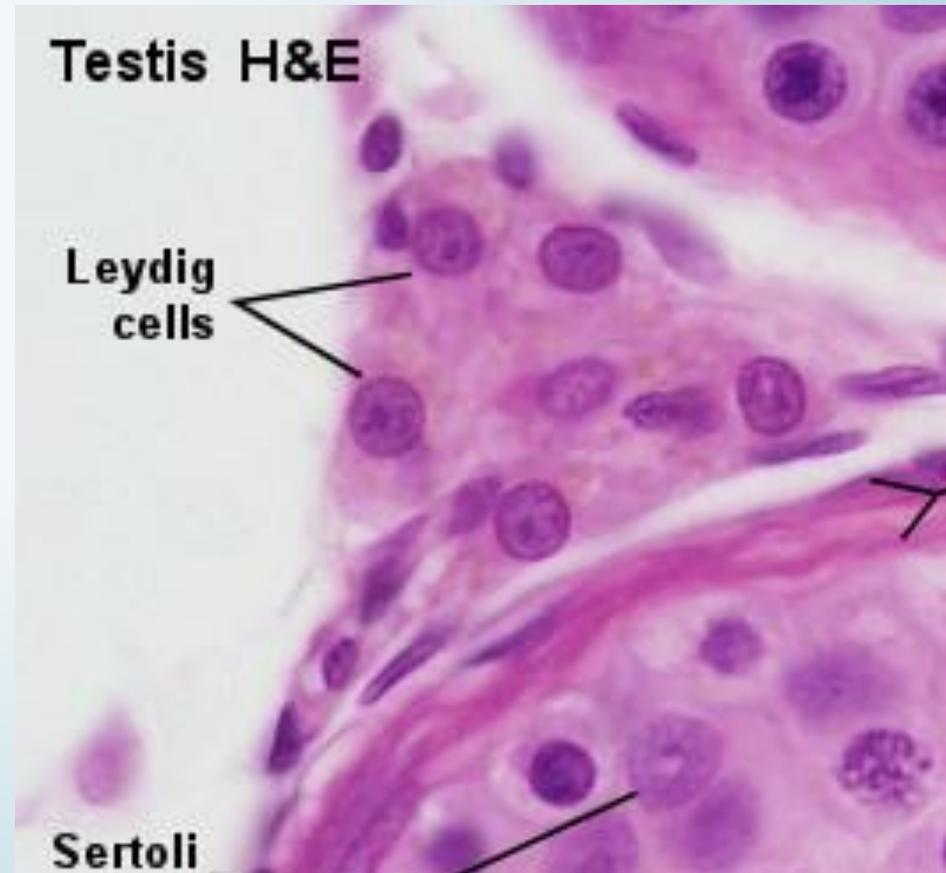
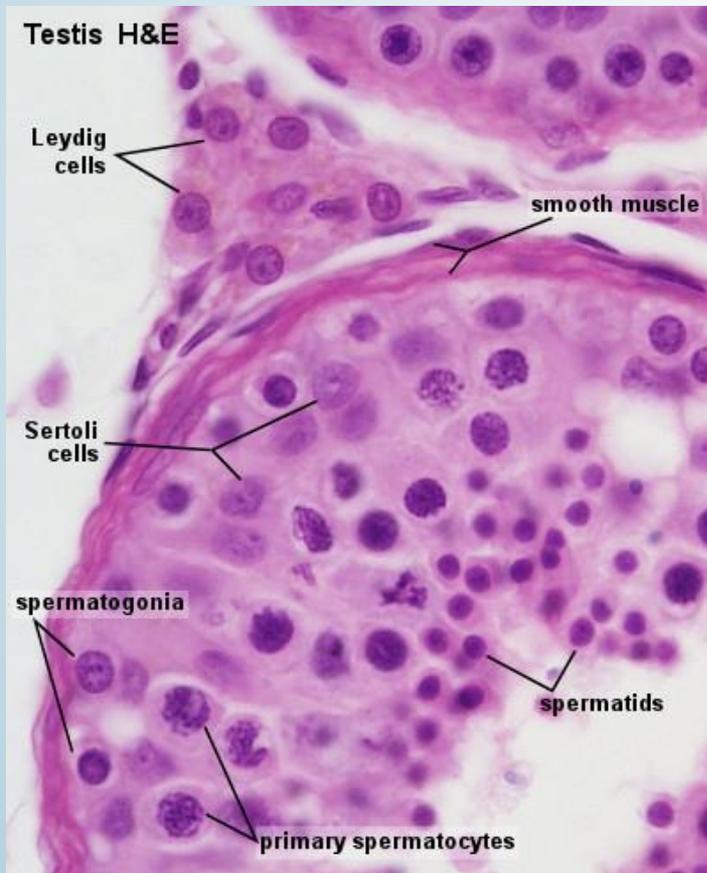
are far less numerous than the spermatogenic cells and are evenly distributed between them. Their shape is highly irregular - columnar is the best approximation. Sertoli cells extend from the basement membrane to the luminal surface of the seminiferous epithelium. Processes of the Sertoli cells extend 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.

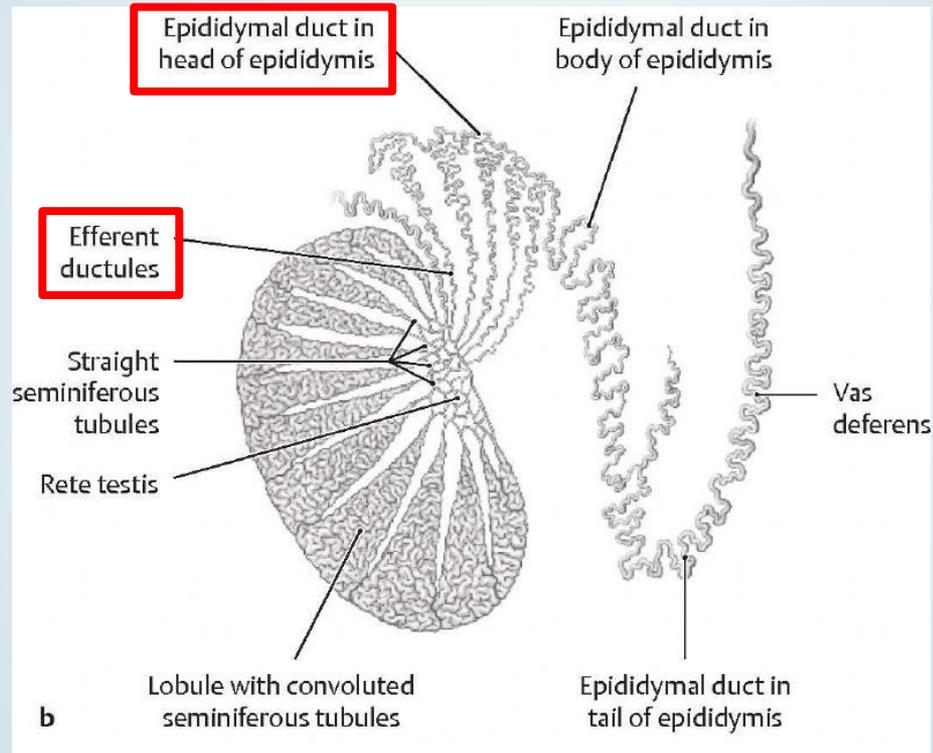


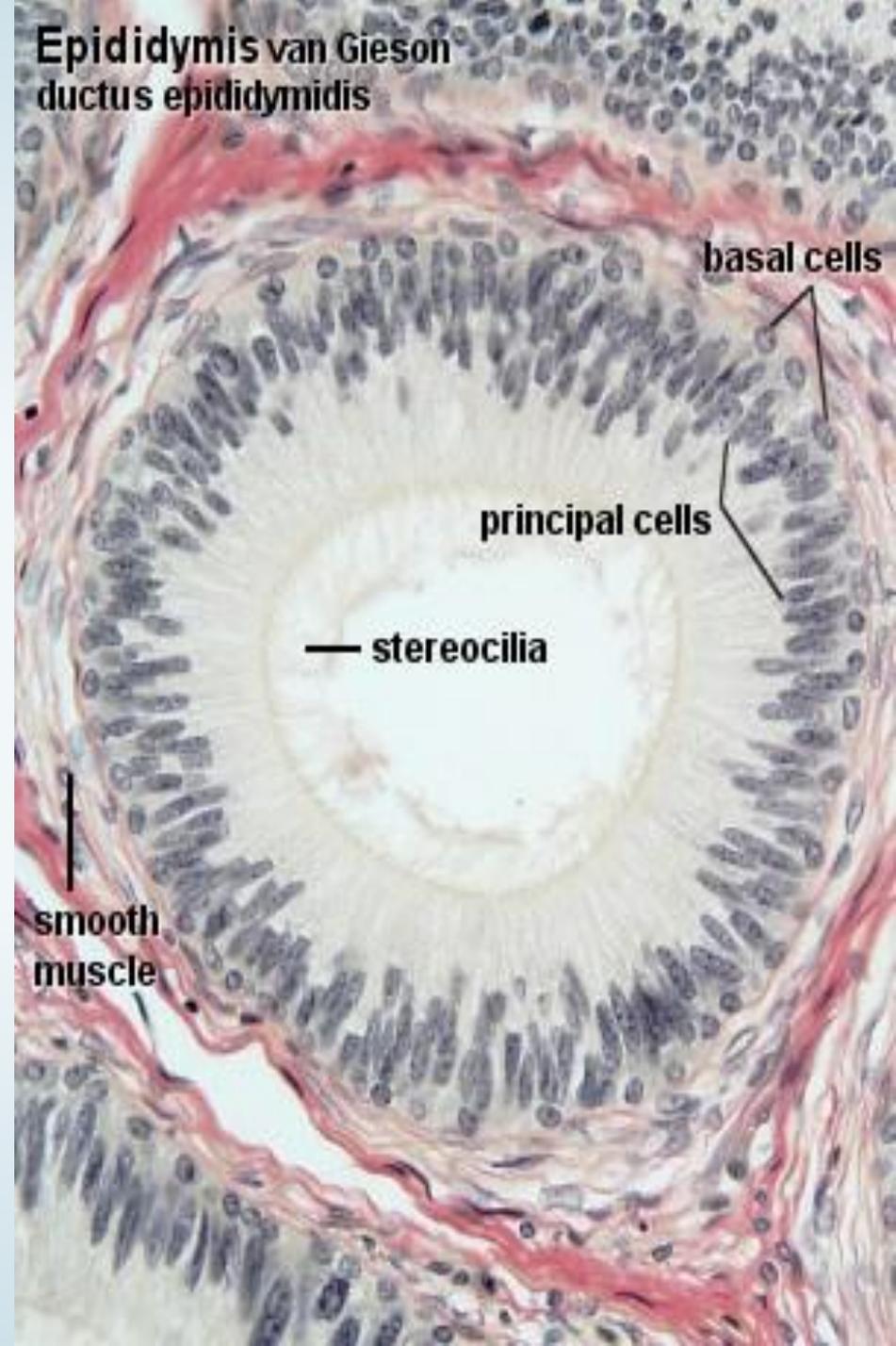
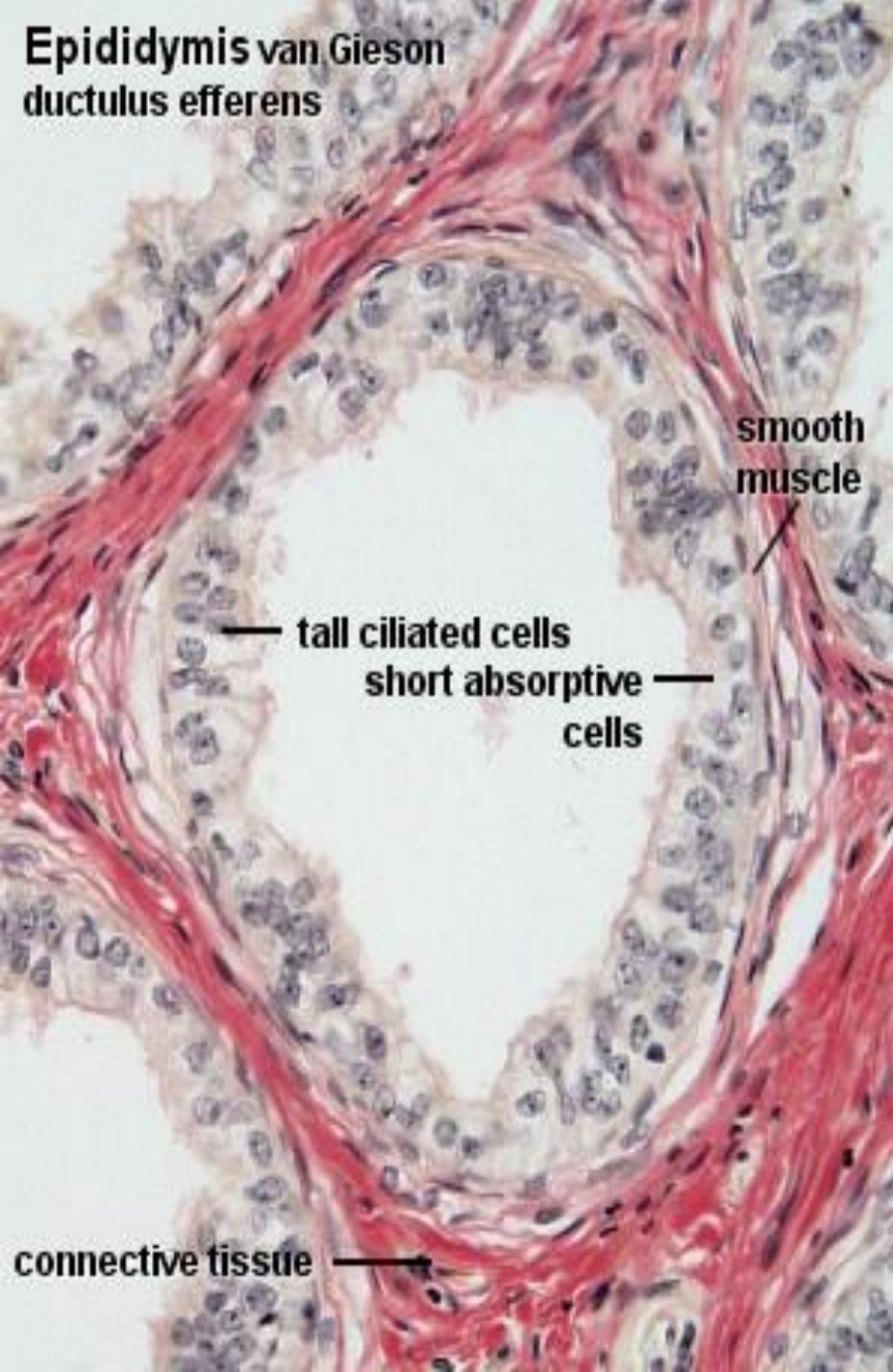
LEYDIG CELLS

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. Leydig 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.

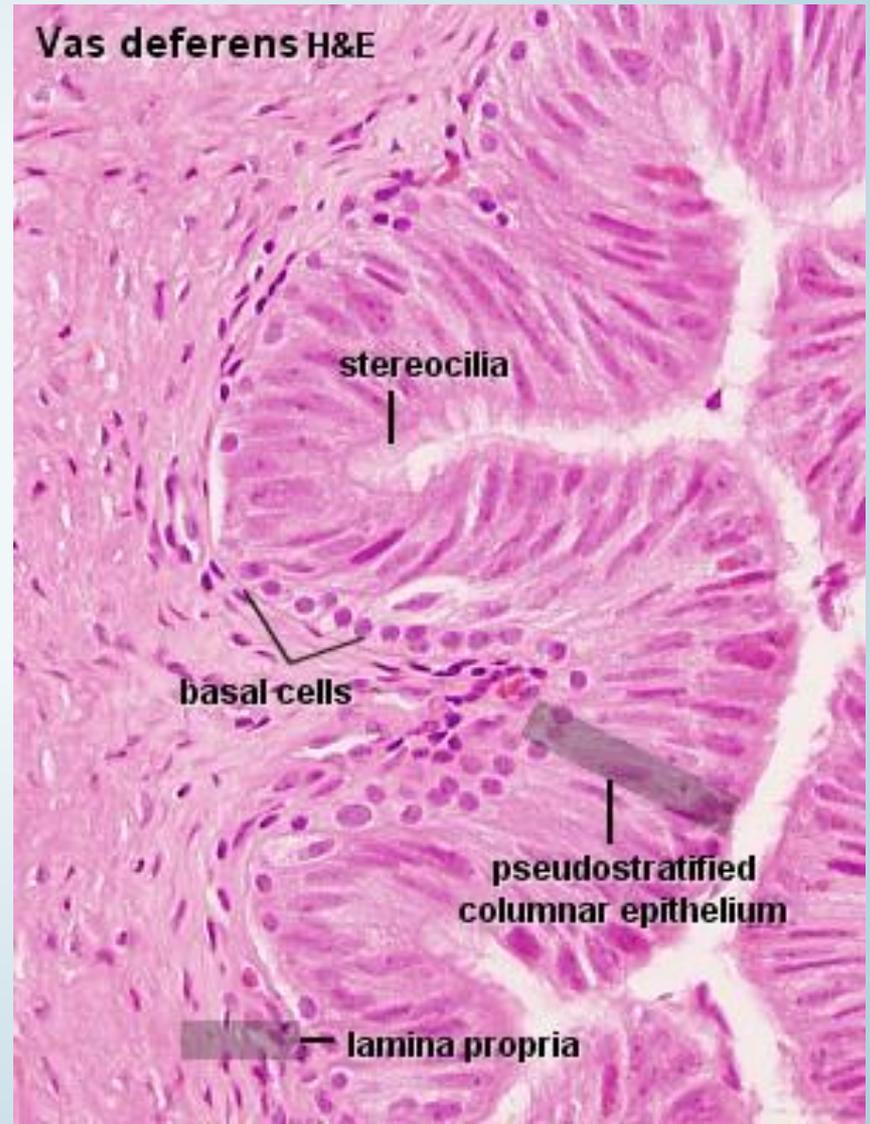
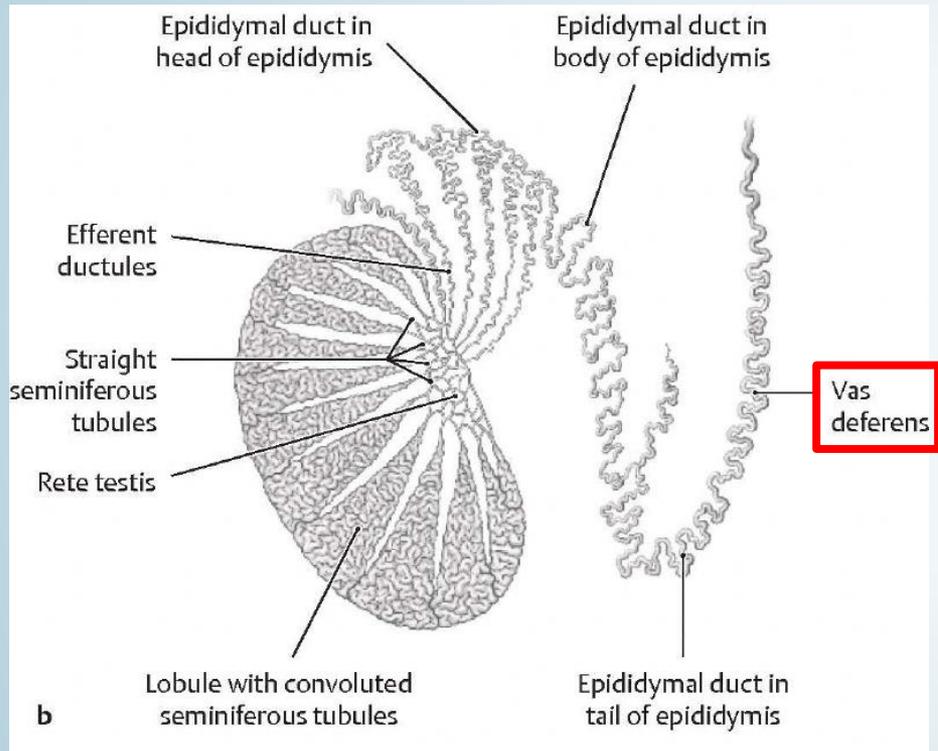


HISTOLOGY OF THE TESTIS AND EPIDIDYMIS

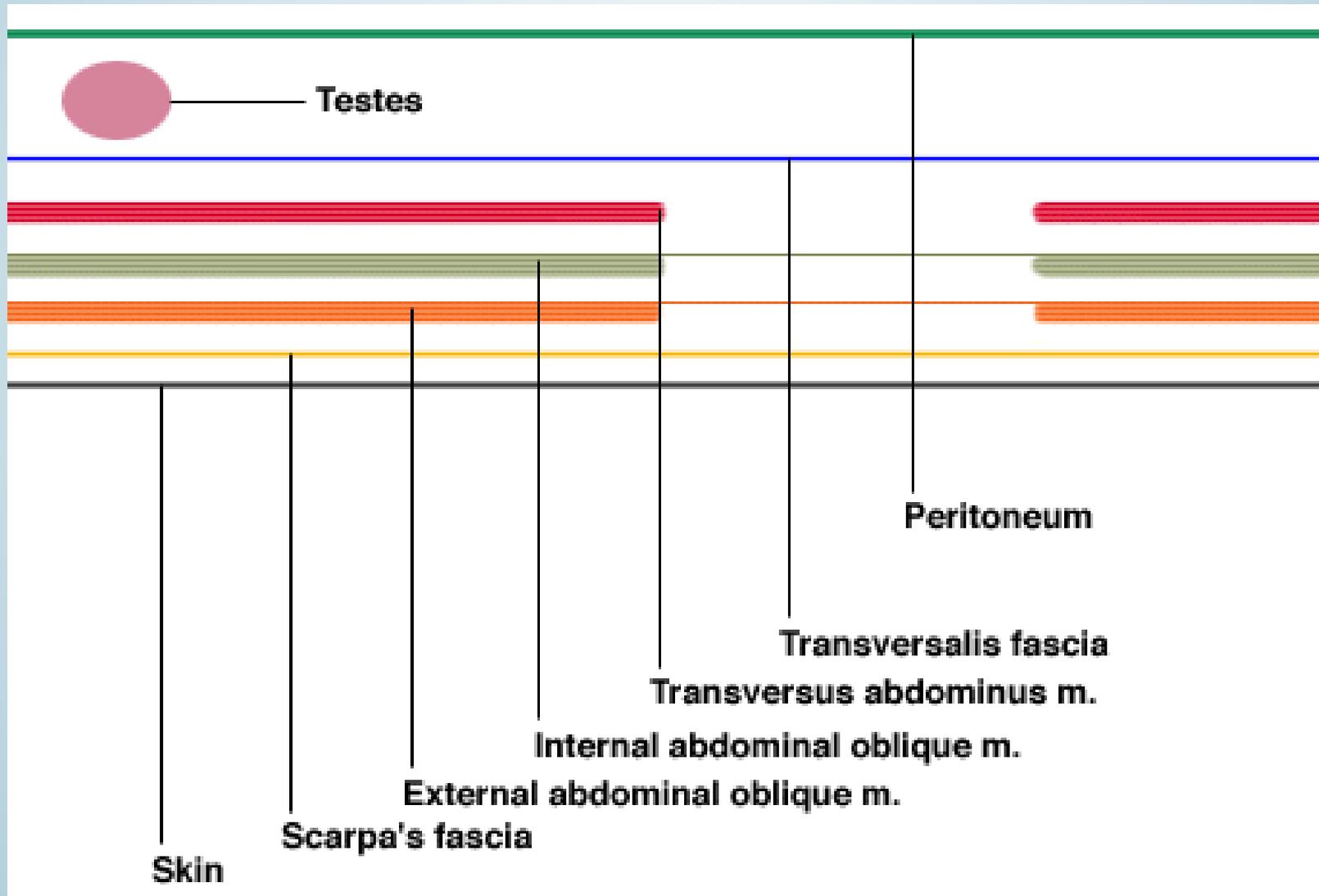




HISTOLOGY OF THE TESTIS AND EPIDIDYMIS



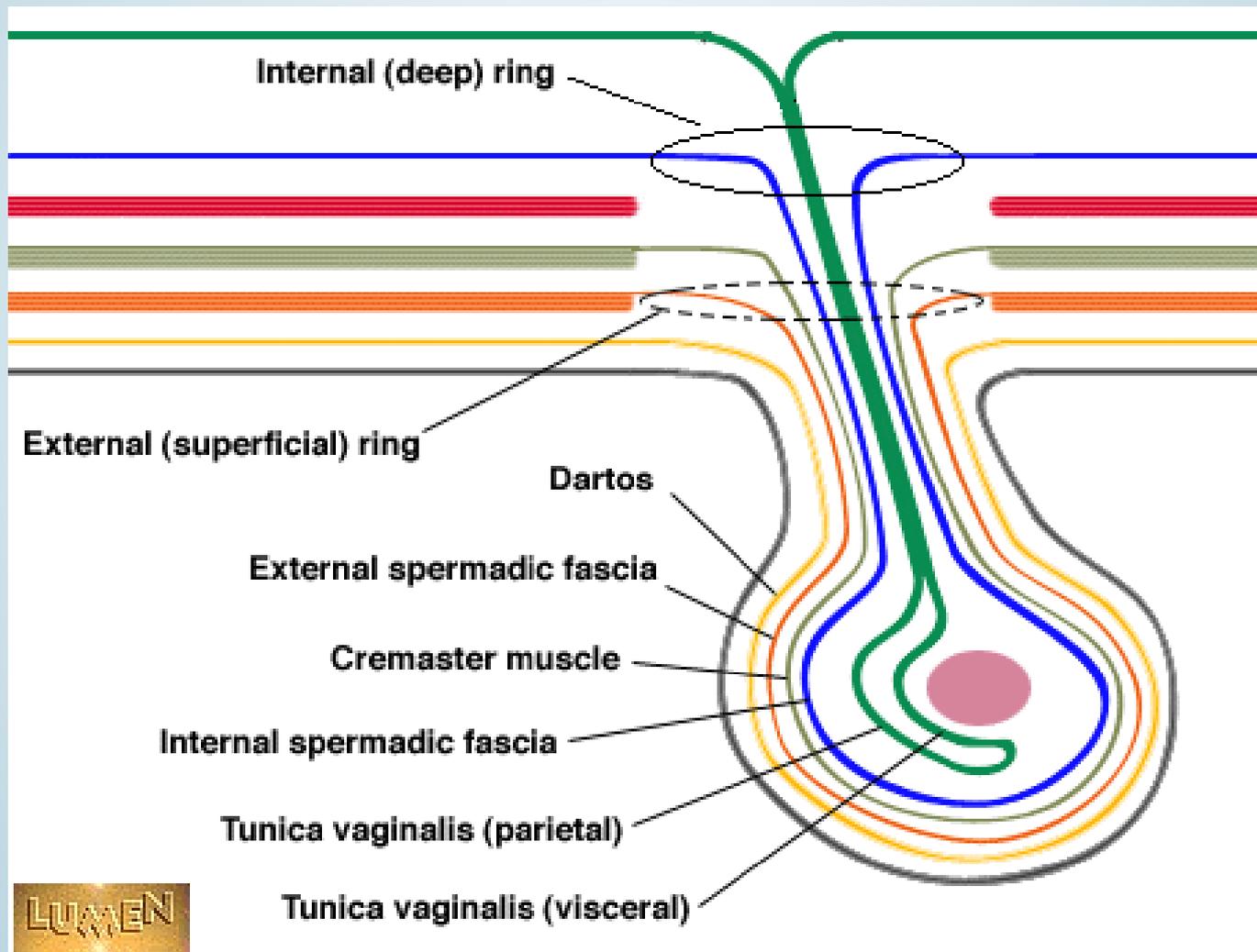
DESCENT OF TESTIS IN THE INGUINAL CANAL



DESCENT OF TESTIS IN THE INGUINAL CANAL



DESCENT OF TESTIS IN THE INGUINAL CANAL



Abdominal wall

skin

Dermis

Superficial fascia

Superf. abdominal fascia

Aponeurosis of the ext. oblique
abdominal m.

Oblique int.
abdominal m.

M. transversus abdominis

Fascia transversalis

Peritoneum

SCROTUM

Skin of the scrotum

Tunica dartos

Ext. Spermatic fascia

Cremaster m.

Int. spermatic Fascia

Tunica vaginalis testis

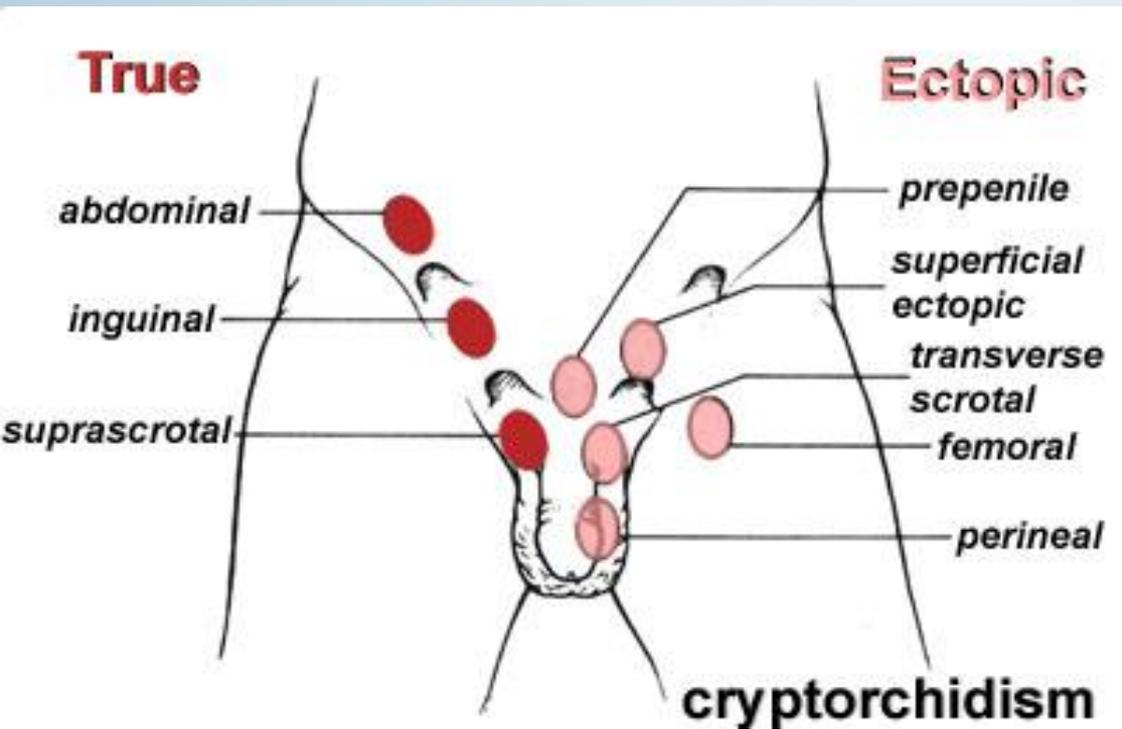
TIMETABLE

*The region, where the testes pass through the abdominal wall, is called the **inguinal canal**.*

*Between the 7th and the 12th week the **gubernaculum shortens** and pulls the testes, the deferent duct and its vessels downwards.*

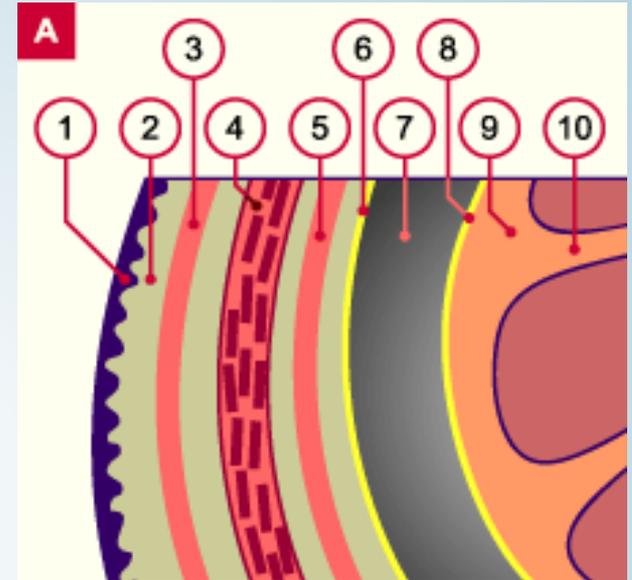
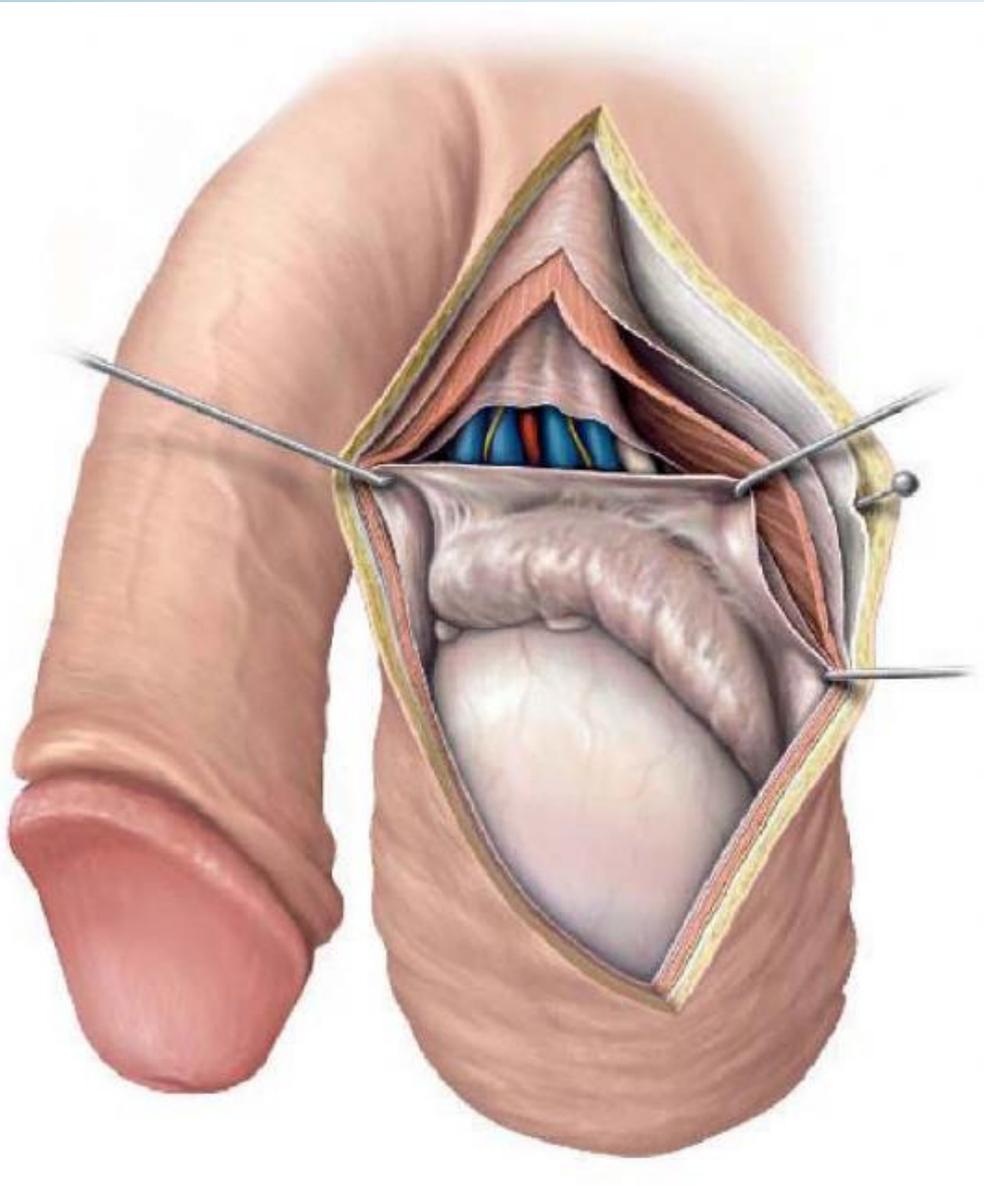
*Between the 3rd and 7th month the **testes** stay in the area of the inguinal canal so they can enter into it. They reach the scrotum at roughly the time of birth under the influence of the androgen hormone.*

*While in the first year of life the upper part of the vaginal process becomes obliterated, there remains only the **peritoneo-vaginal ligament**. The lower portion persists as the **tunica vaginalis testis**, which consists of a parietal and a visceral layer.*

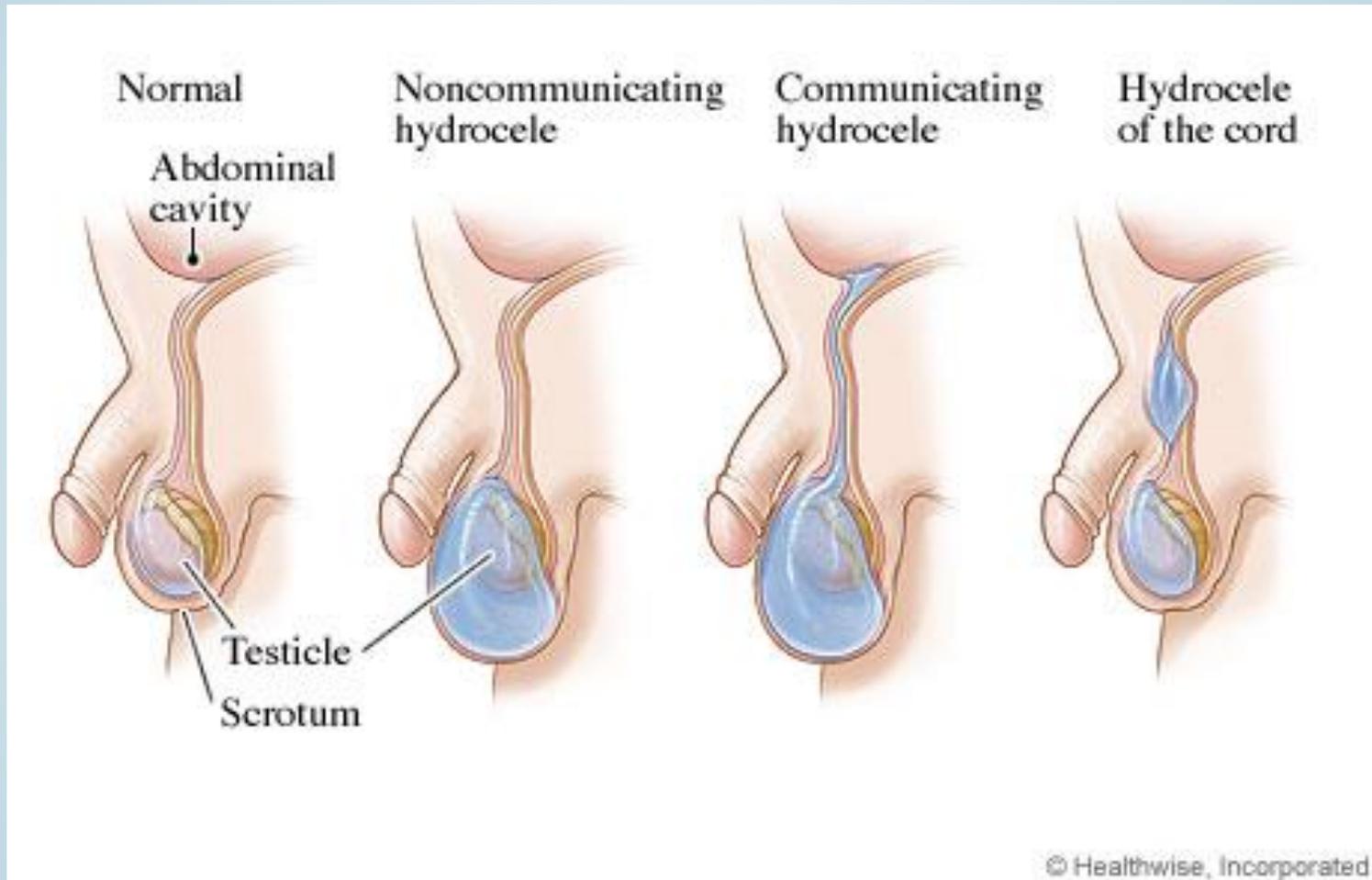


Cryptorchidism is an abnormality of either unilateral or bilateral testicular descent, occurring in up to 30% premature and 3-4% term males. Descent may complete postnatally in the first year, failure to descend can result in sterility.

Coats of the testicles



- 1 Epidermis
- 2 Dermis (tunica dartos)
- 3 External spermatic fascia
- 4 Musculus cremaster
- 5 Internal spermatic fascia
- 6 Parietal lamina of the tunica vaginalis
- 7 Virtual cavity between the two layers of the tunica vaginalis
- 8 Visceral lamina of the tunica vaginalis
- 9 Tunica albuginea
- 10 Interlobular septum of the testis

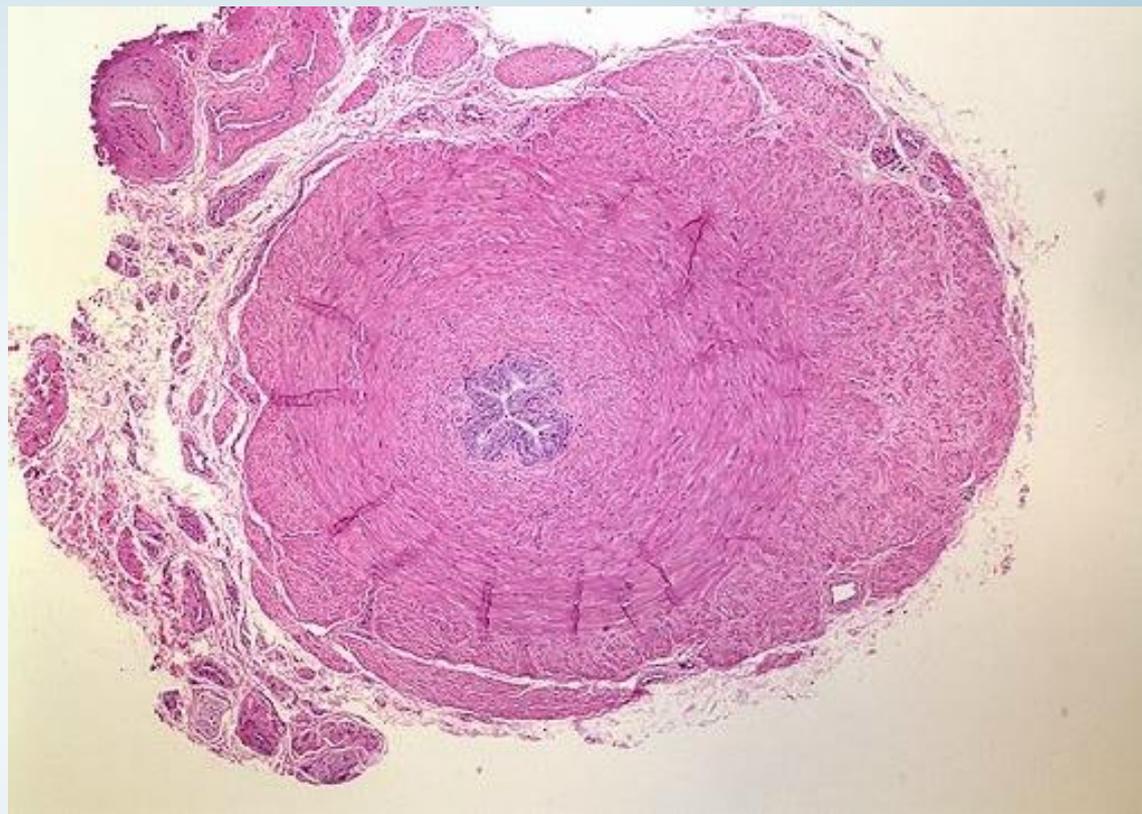
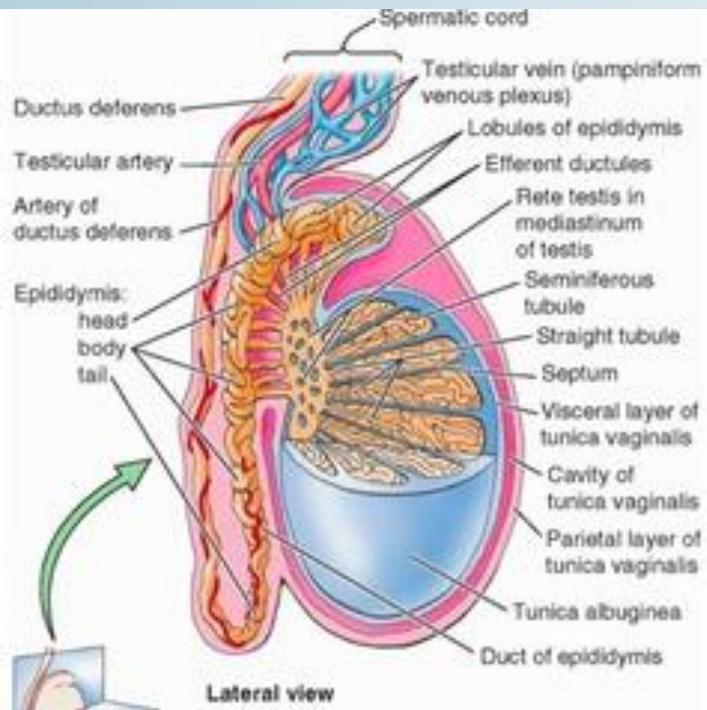


Hydrocele a fluid-filled cavity of either testis or spermatic cord, where peritoneal fluid passes into a patent processus vaginalis.

HYDROCELE



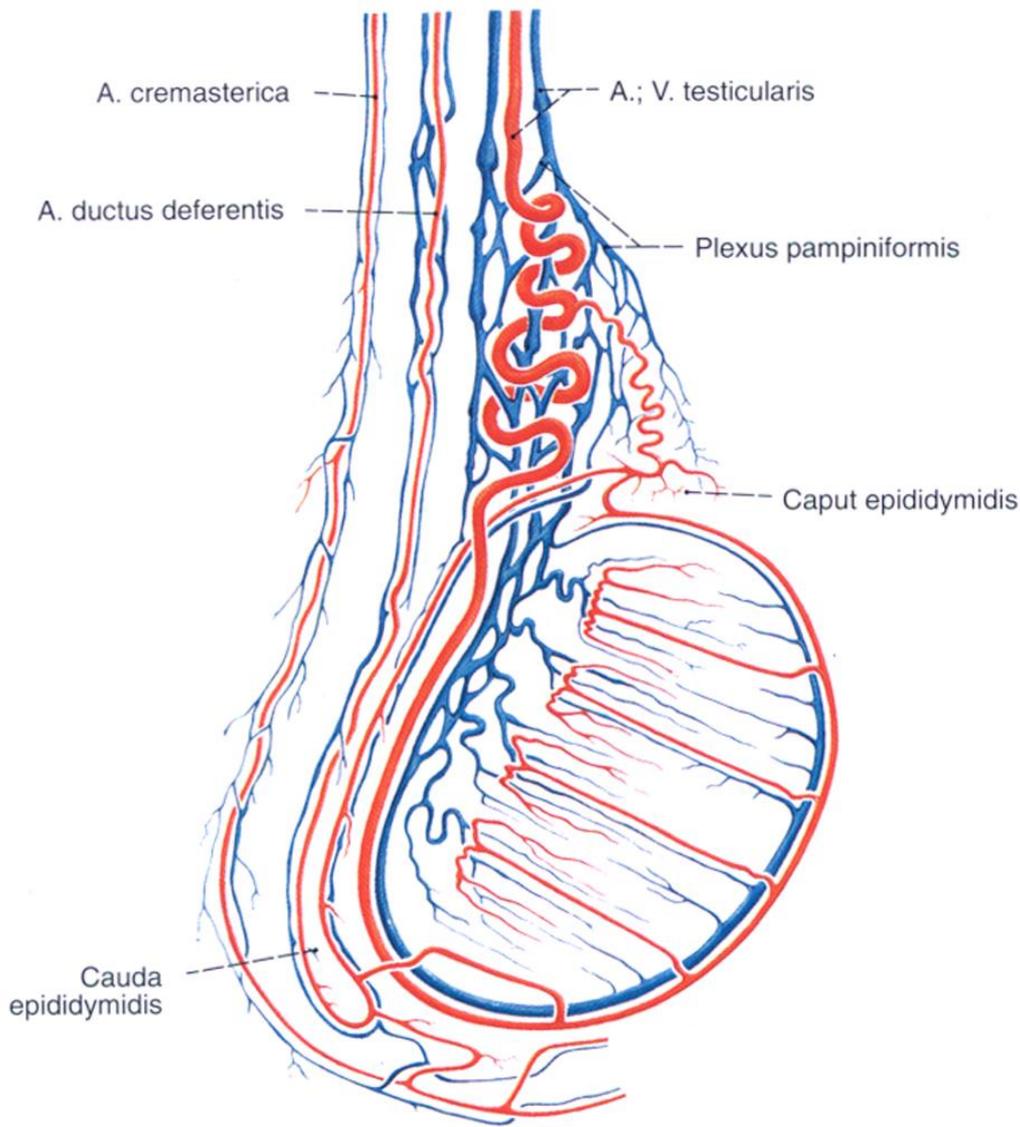
SPERMATIC CORD



The classic and memorable description of the contents of spermatic cord in the male are:

- 3 arteries: cremasteric artery, deferential a., testicular a.;
- 3 nerves: genital branch of the genitofemoral n. (L1/2), autonomic and visceral afferent fibres, ilioinguinal n. (N.B. outside spermatic cord but travels next to it)
- 3 fascial layers: external spermatic, cremasteric, and internal spermatic fascia;
- 3 other structures: pampiniform plexus, vas deferens (ductus deferens), testicular lymphatics;

BLOOD SUPPLY



Testicular a.:

From the Aorta (L1-2)

Anastomosis with:

Vas deferens a.

Cremasteric a.

Inf. Epigastric a.

Veins:

Pampiniform plexus → Testicular v.

left: Renal v.

right: inf. V. cava

Lymphatic vessels:

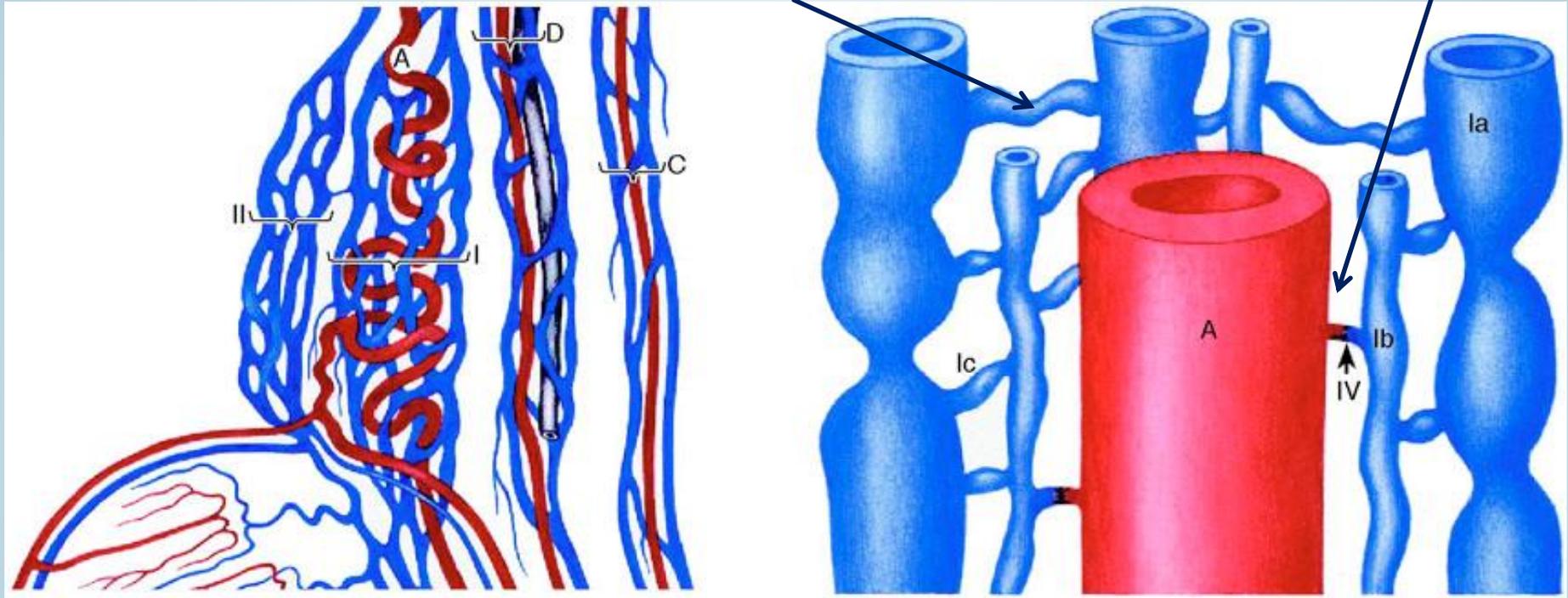
testis: lumbal lymph nodes

scrotum, coats: inguinal lymph nodes

TESTICULAR CIRCULATION

Anastomosis between veins

Arteriovenous anastomosis



Venous plexuses around the:

- Testicular a.
- Vas deferens a.
- Cremasteric a.

Independent venous plexuses

Muscular veins! → constrictions, regulation of circulation

Arteriovenous 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

- *Genital branch of genitofemoral nerve*
- *Anterior scrotal nerves (from ilioinguinal nerve)*
- *Posterior scrotal nerves (from perineal nerve)*
- *perineal branches of posterior femoral cutaneous nerve*

Surface

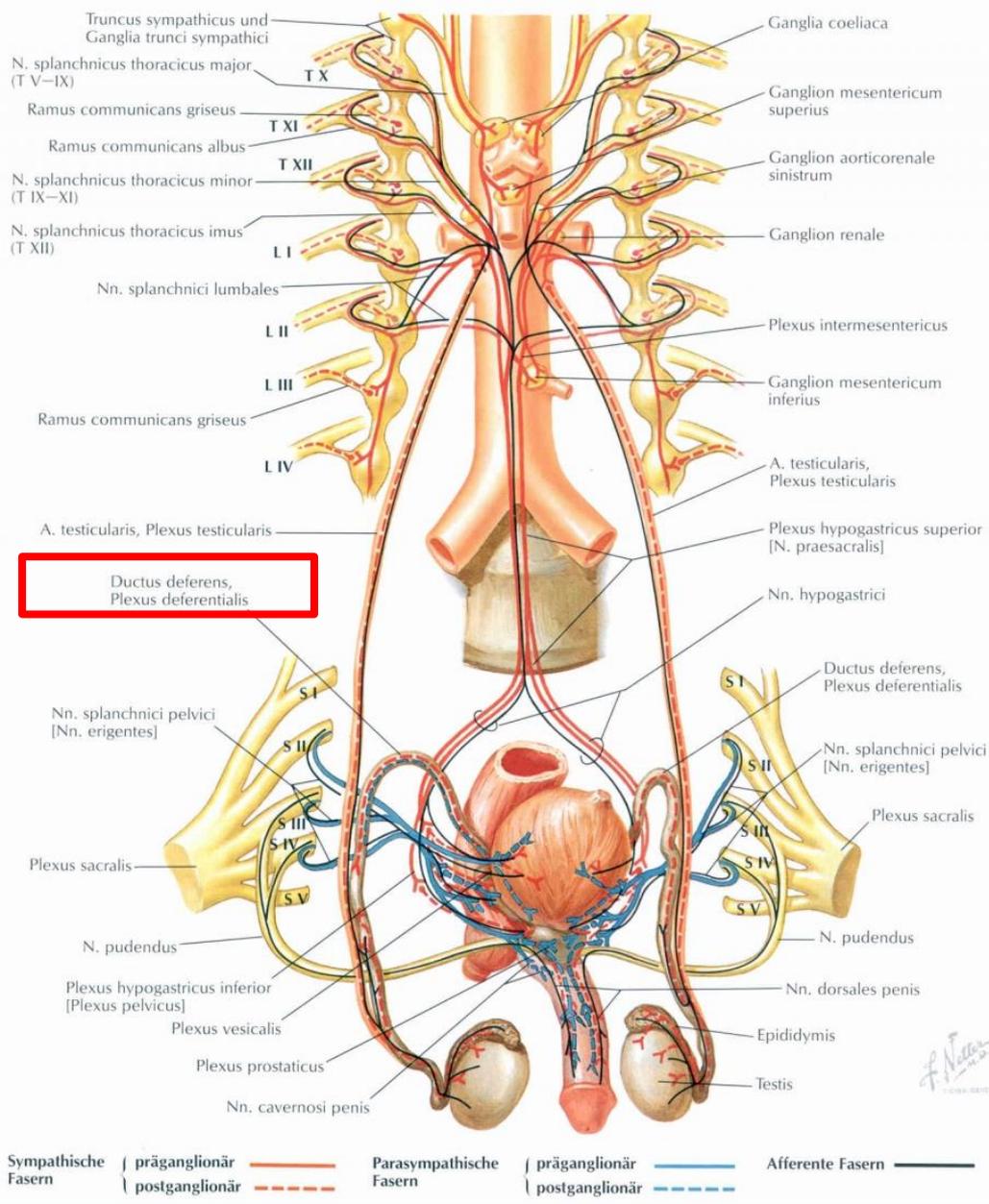
- anterolateral*
- anterior*
- posterior*
- inferior*



INNERVATION 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

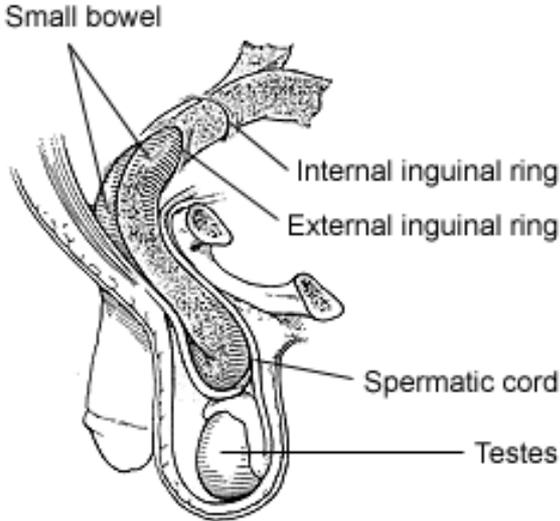


human



Dog (left: normal testis)

Inguinal Hernia



There are two types of inguinal hernia, *direct* and *indirect*, which are defined by their relationship to the inferior epigastric vessels.

Type	Description	Relationship to <u>inferior epigastric vessels</u>	Covered by <u>internal spermatic fascia</u> ?	Usual onset
<u>indirect inguinal hernia</u>	protrudes through the inguinal ring and is ultimately the result of the failure of embryonic closure of the internal inguinal ring after the <u>testicle</u> passes through it	Lateral	Yes	Congenital
<u>direct inguinal hernia</u>	enters through a weak point in the fascia of the abdominal wall (<u>Hesselbach triangle</u>)	Medial	No	Adult