

Male genital system

Systema genitale masculinum

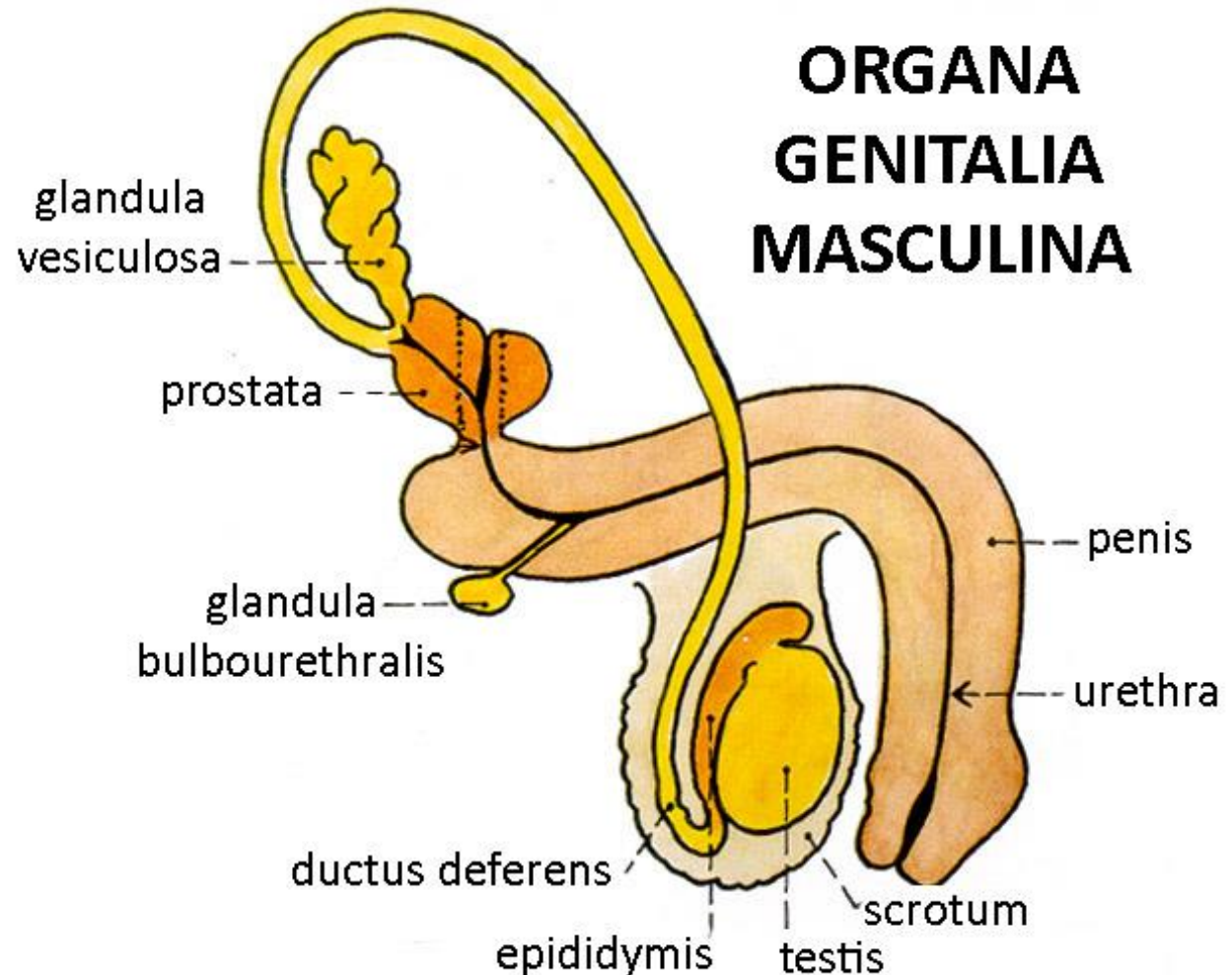


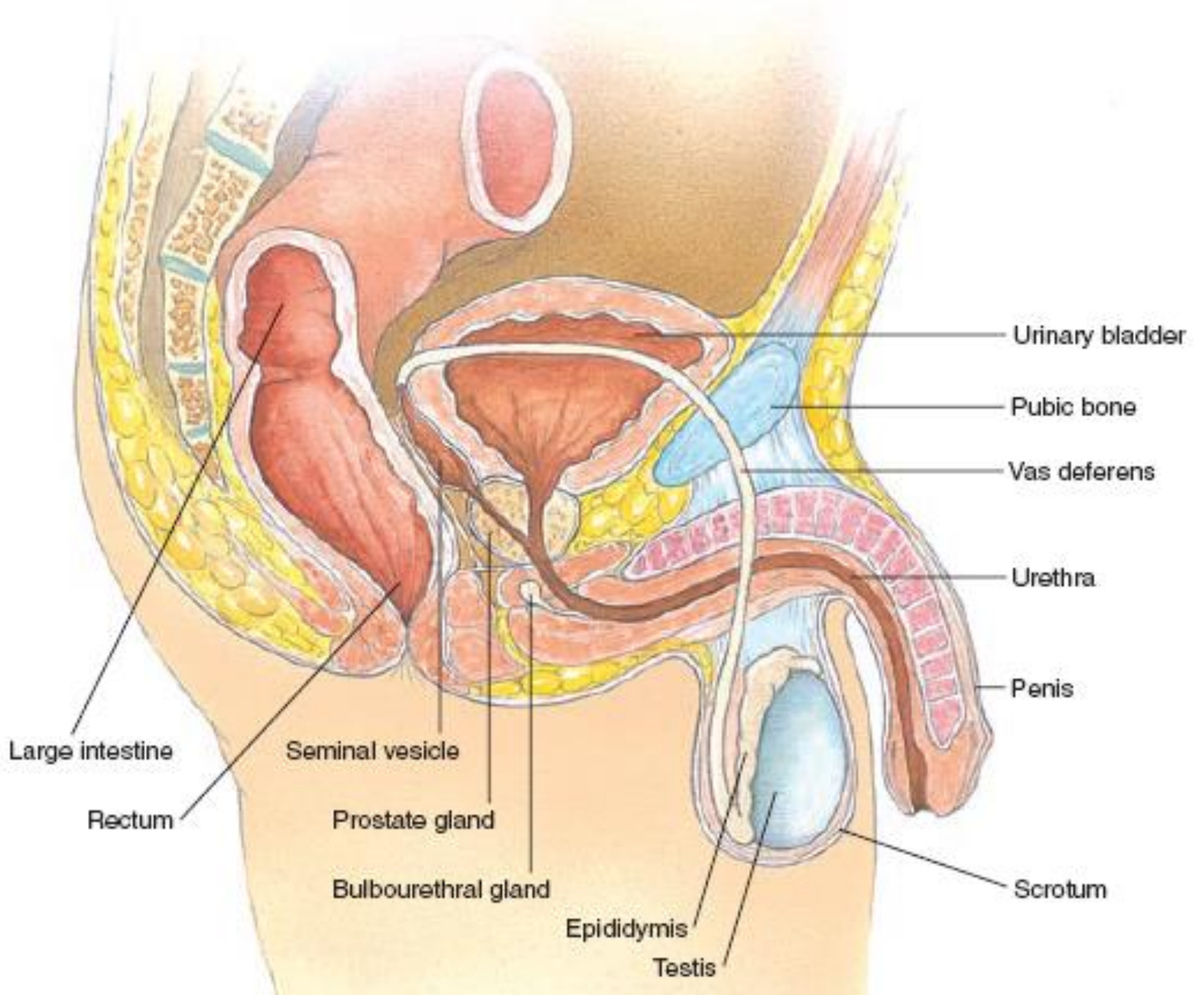
Organa genitalia masculina interna

- testis (*orchis*)
- epididymis
- funiculus spermaticus = spermatic cord
 - including ductus deferens
- glandula vesiculosa / seminalis (vesiculae seminales) = seminal gland / vesicles
- prostata = prostate
- glandula bulbourethralis = bulbo-urethral gland

Organa genitalia masculina externa

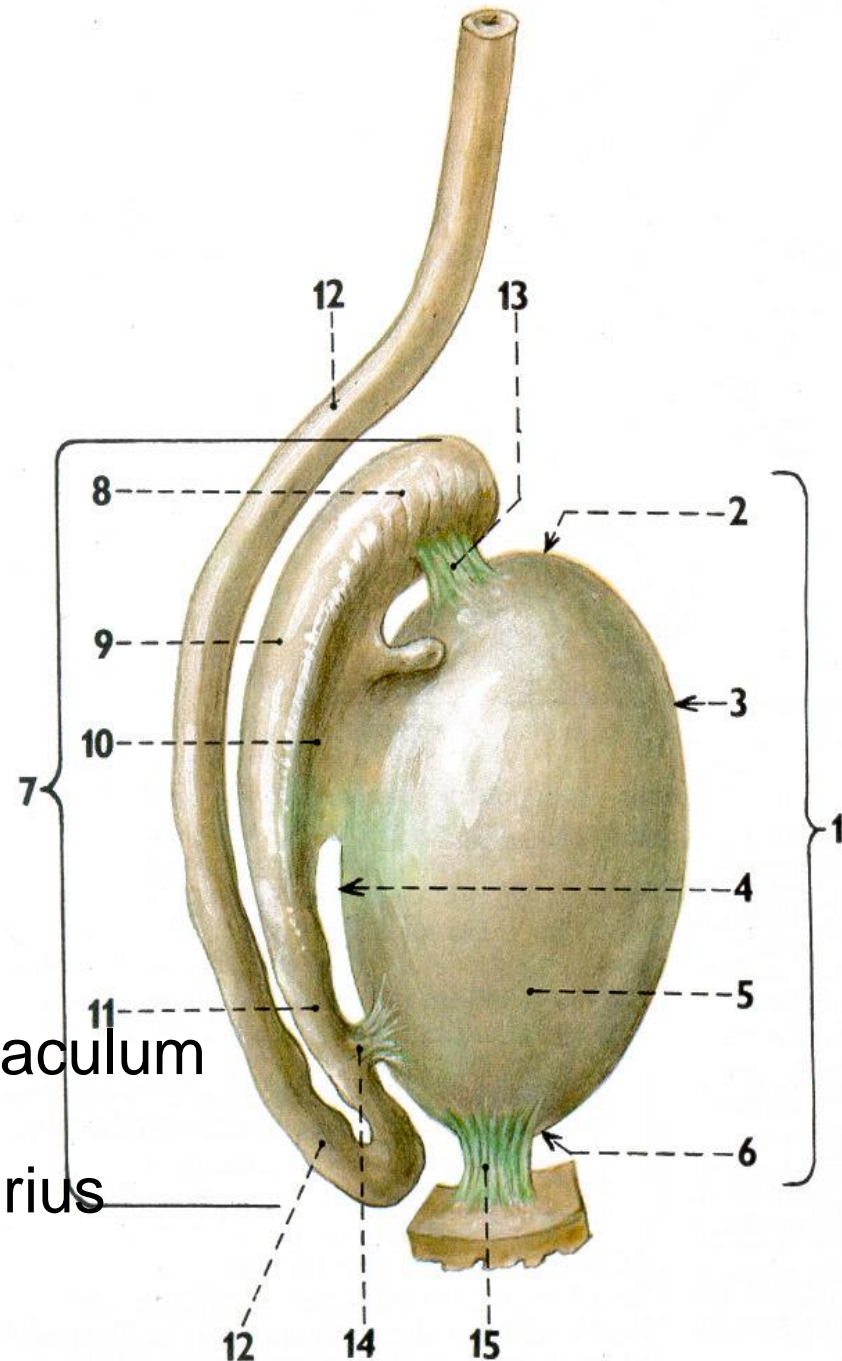
- penis
- urethra masculina = male urethra
- scrotum





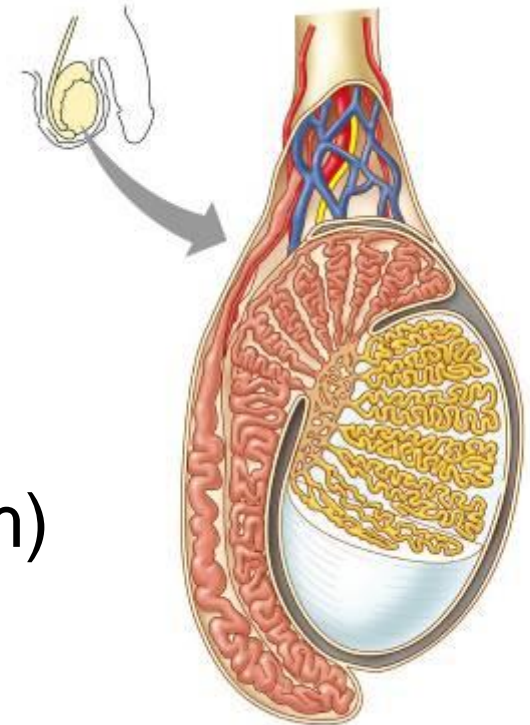
Testis, gr. orchis

- external features
 - extremitas superior + inferior
 - facies medialis + lateralis
 - margo anterior + posterior
- covers and layers
 - tunica vaginalis
 - lamina parietalis
 - cavitas vaginalis testis
 - lamina visceralis
 - tunica albuginea
- ligaments
 - lig. scrotale (remnant of gubernaculum testis)
 - lig. epididymidis superius + inferius
- temperature: 2°C lower

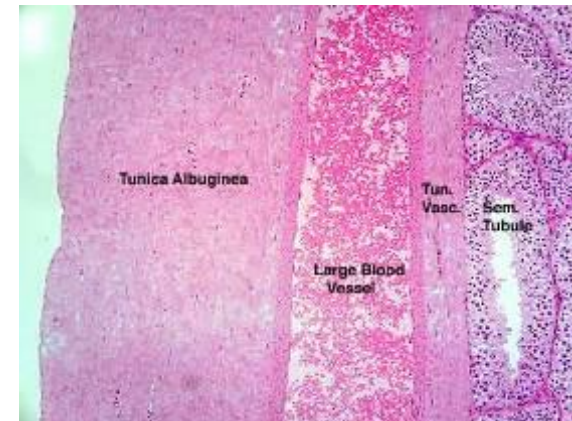


Testis – *internal features*

- tunica albuginea → septula
 - tunica vasculosa
 - parenchyma testis → lobuli testis (200-300)
 - mediastinum testis
 - tubuli seminiferi contorti (30-70 cm)
 - spermatogenic / germinal epithelium (complex pseudostratified)
- tubuli recti testis → rete testis → ductuli efferentes testis (already within caput epididymidis)

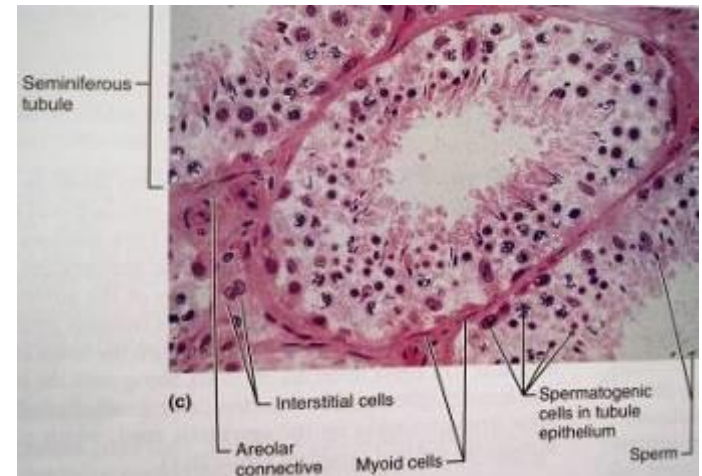


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Seminiferous tubules

- lumen 200 μm
 - **spermatogenic epithelium** (complex pseudostratified) – 80 μm high
 - spermatogenic cells
 - **Sertoli** cells
- basement membrane
- stratum myoideum
 - myoid / peritubular cells (myofibroblasts)
- stratum fibrosum

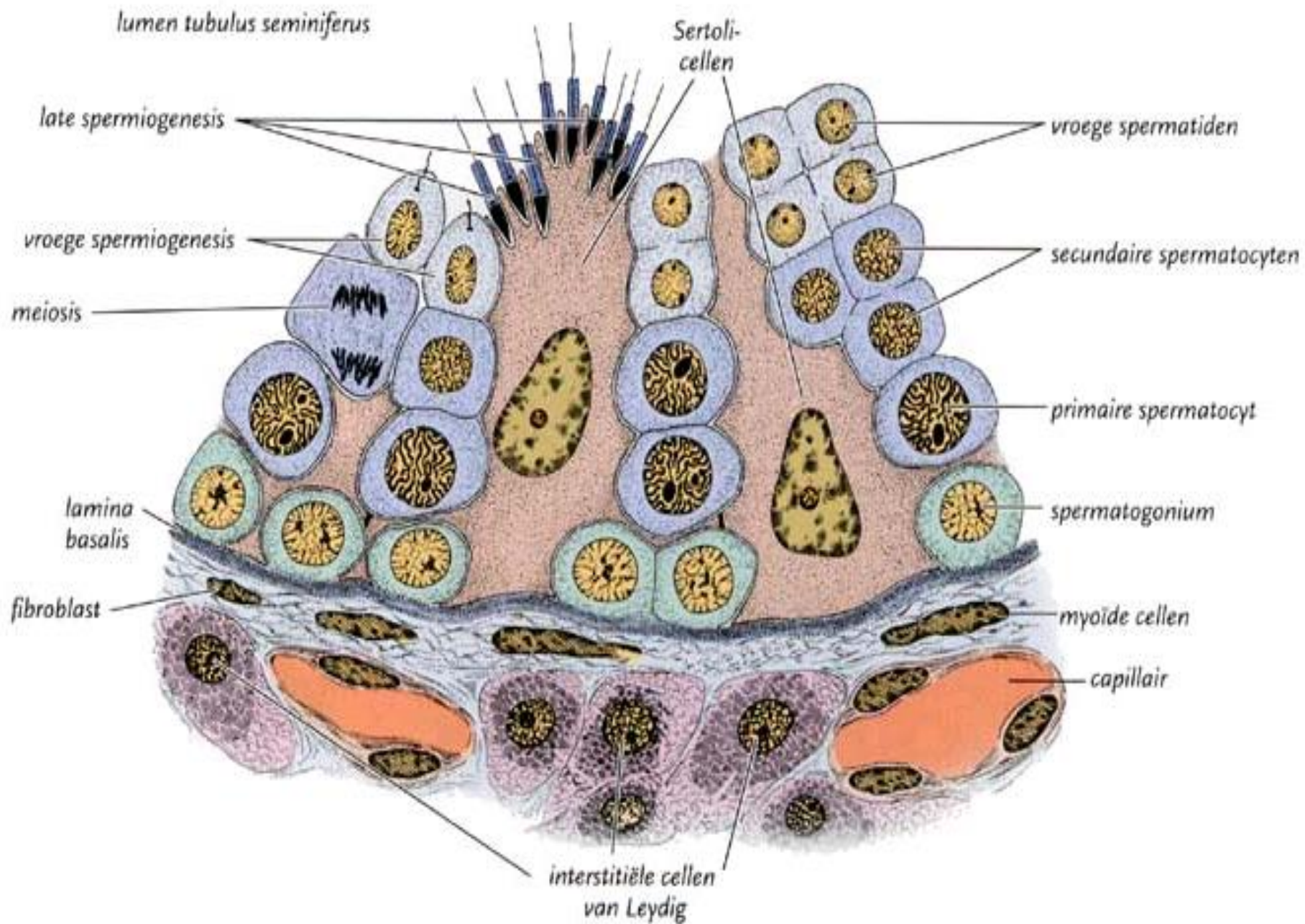


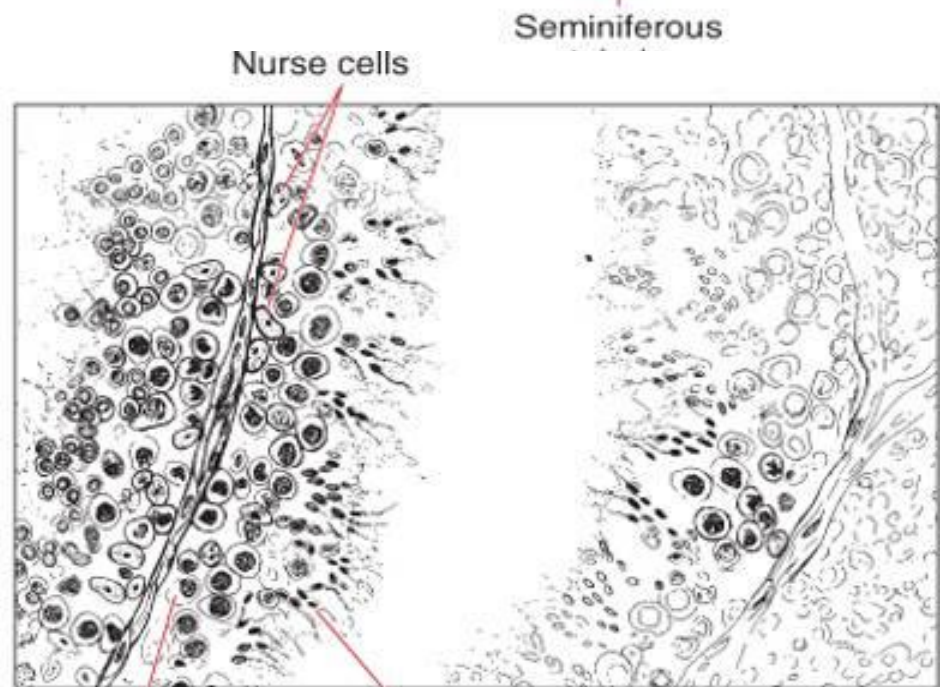
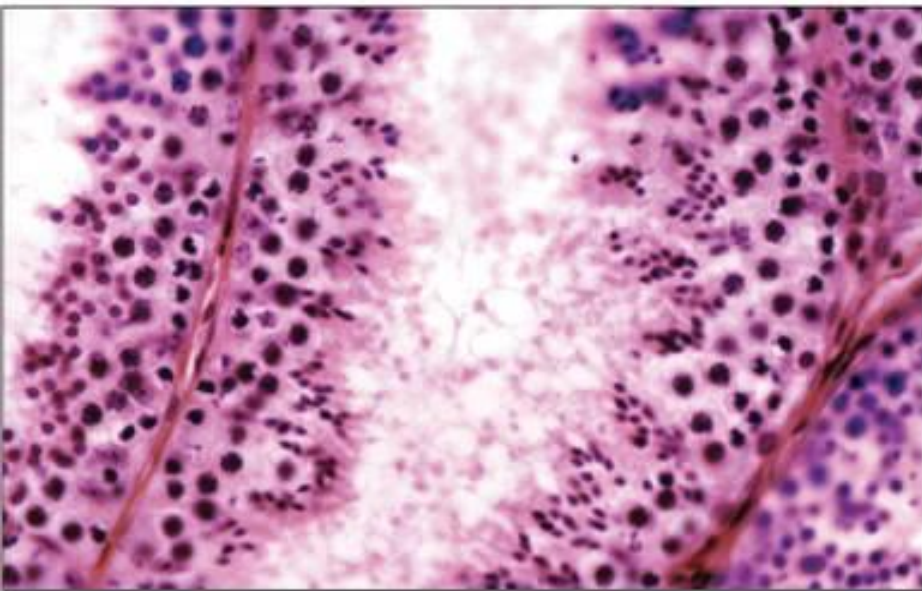
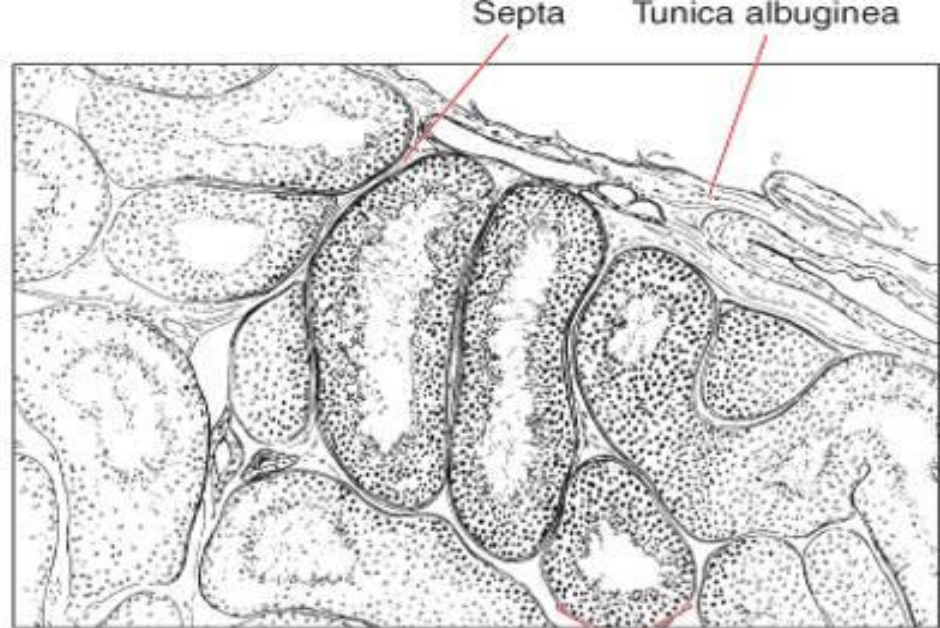
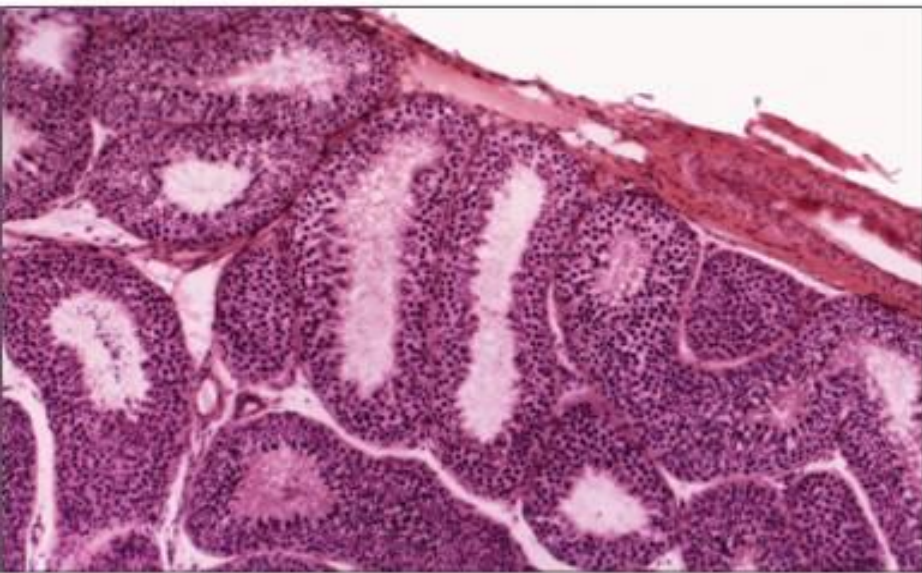
Spermatogenic epithelium

Epithelium spermatogenicum

- spermatogenic cells (*cellulae spermatogenicae*)
 - individual stages of sperm development = **spermatogenesis**
 - 4-8 rows of nuclei
 - **spermatogonia** (type A and B)
 - at tubule wall, *mitotic division*
 - B pass into the adluminal compartment
 - **primary spermatocytes**
 - divide in the 1st *meiotic division*
 - **secondary spermatocytes**
 - divide in the 2nd *meiotic division*
 - **spermatids (*spermatidia*)**
 - mature and are released into the tubular lumen, rinsed away
 - spiral arrangement
 - **64 days = spermatogenesis**







Septa Tunica albuginea

Seminiferous

Nurse cells

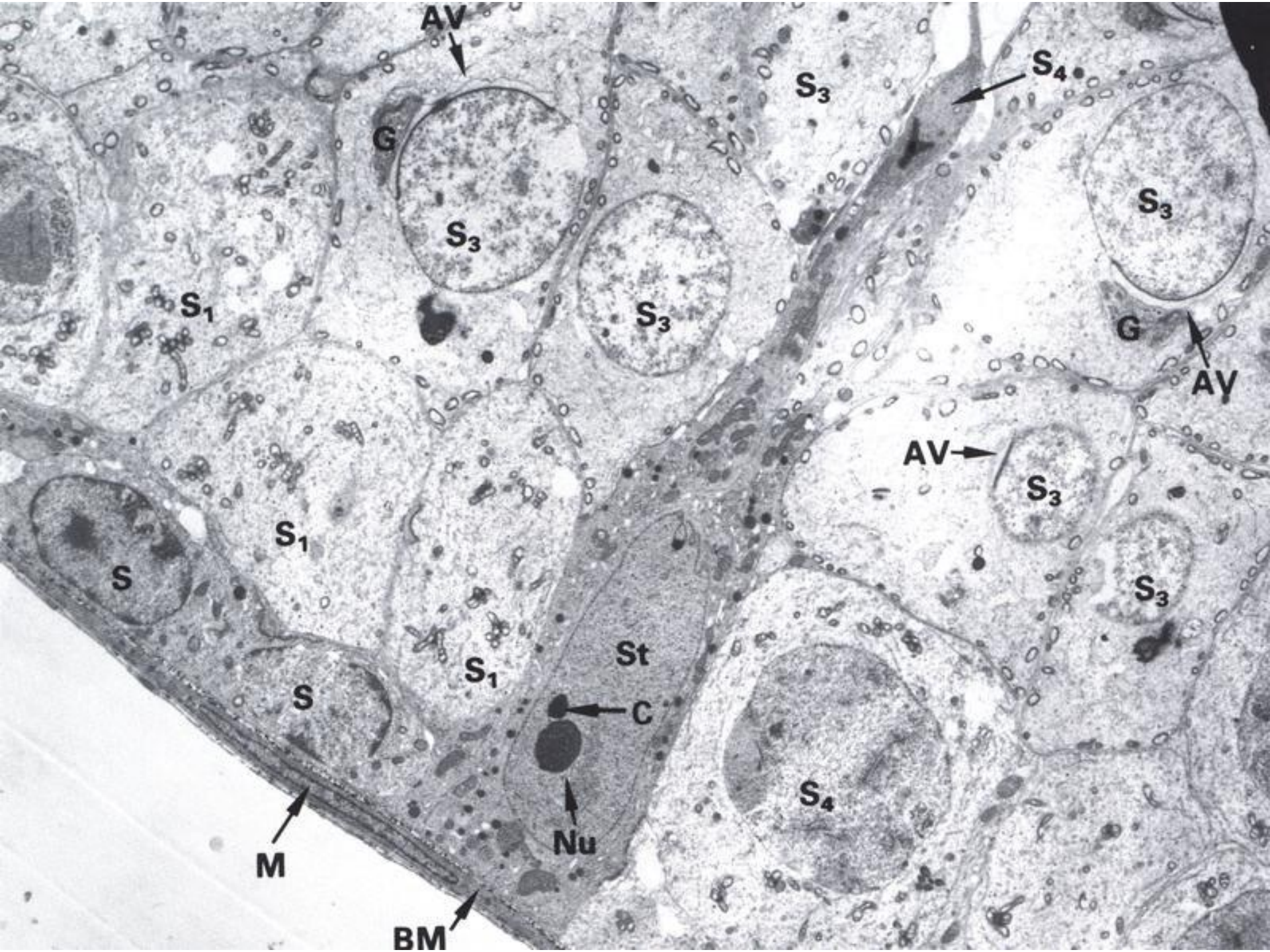
Primary spermatocyte

Late spermatid

Sertoli cells

Sustenocytii (Epithelocytii sustentantes)

- covering the maturing spermatogenic cells
- long cone shape, nucleus basally
- **hemato-testicular barrier** (*claustrum haematotesticulare*)
 - zonulae occludentes (tight junctions) between cells
 - protection against foreign substances
 - immunobiologic environment
- **compartimentum adluminale**
 - specific environment
- **apparatus junctionalis sustentocyticus**
 - zonulae occludentes between both compartments
- **compartimentum basale**
 - corresponds to the blood environment



Sertoli cells

Sustenocytii (Epithelocytii sustentantes)

- **nutrition and support**
- phagocytosis (residual bodies remaining from the sperm maturation)
- **testicular fluid**
- androgen-binding protein (ABP) binds testosterone and elevates its level within the tubular lumen
- **anti-müllerian hormone (AMH)** = Müllerian inhibiting factor/ substance (MIF/MIS) makes the ductus paramesonephricus Mülleri to fade out
- **inhibin** inhibits the secretion of FSH
- extremely resistant to all adverse effects including radiation → they do not divide

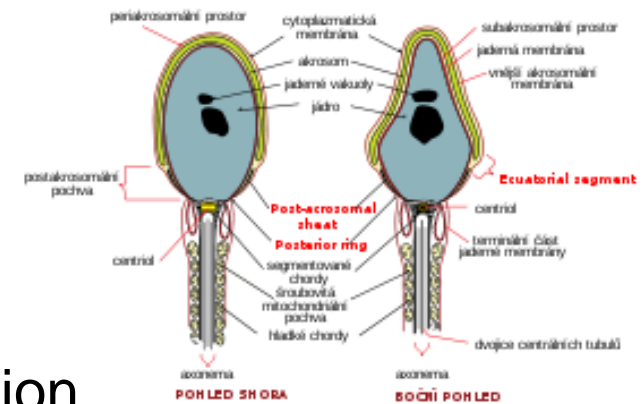
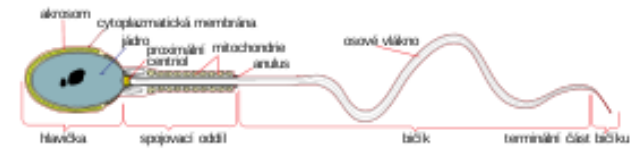
Spermiogenesis



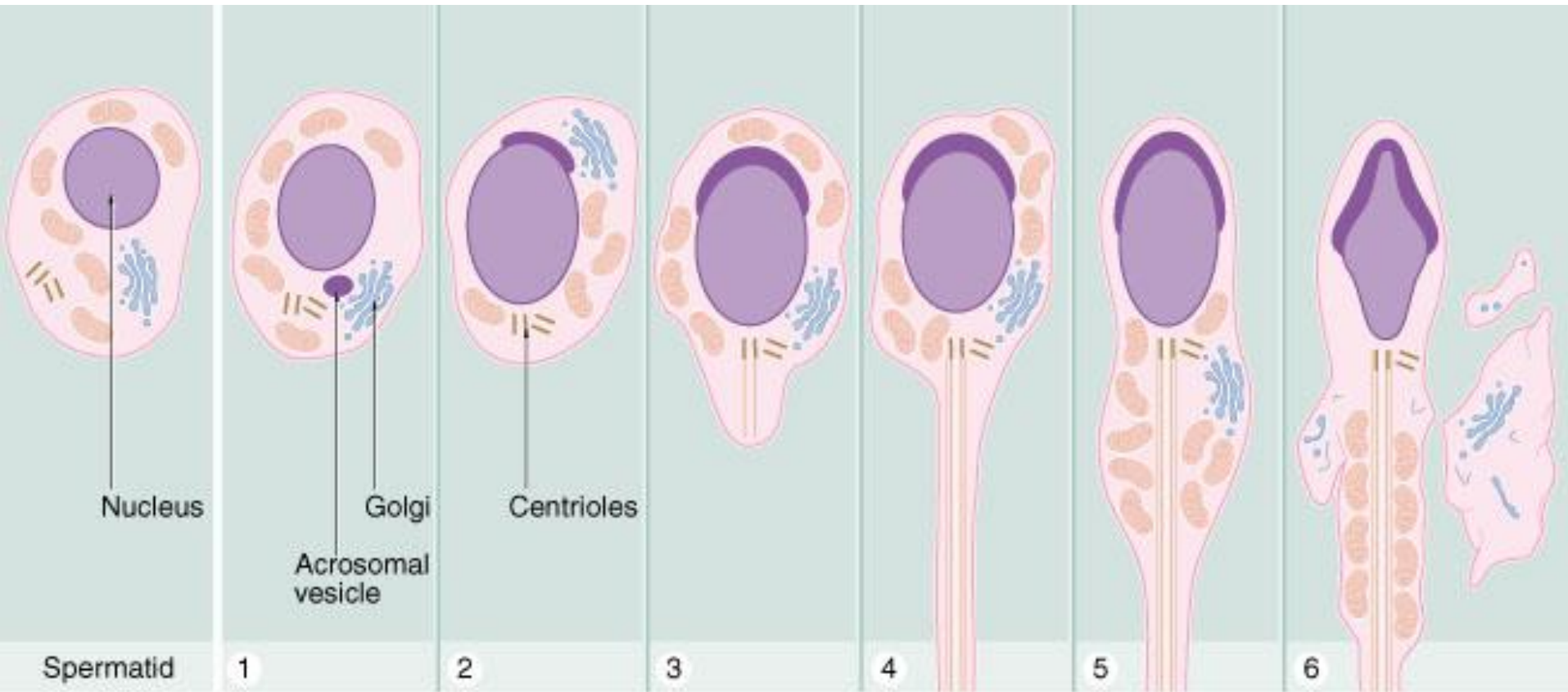
- in canalis epididymidis
- spermatids
 - condensed chromatin, \uparrow mitochondria
 - Golgi phase
 - cap / acrosomal phase
 - maturation phase
- from spermatogonia to sperm: **64 ± 4.5 days**
- spermatogenic epithelium cycle: **16 ± 1 days**
 - period after which a certain developmental stage appears again at the certain spot

Sperm; Sperm cell; Male gamete (*Spermatozoon; Spermium; Gametus masculinus*)

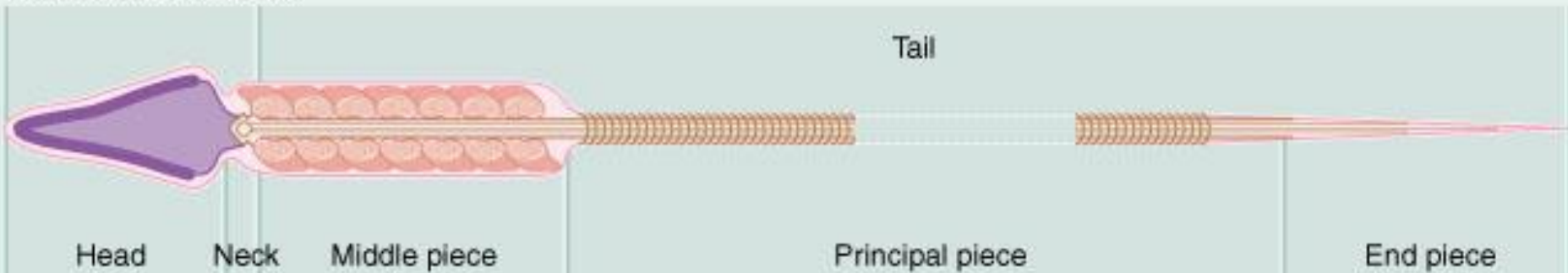
- 60 μm
- head (*caput*) – 4 μm
 - haploid nucleus
 - acrosome (*acrosoma*)
 - enzymes (acrosine) – acrosomal reaction
 - centrioles – termination of oocyte division
- neck (*collum*)
- *flagellum*
 - middle piece (*pars intermedia*) with mitochondria
 - principal and end piece (*pars principalis et terminalis*)
 - 9 x 2 + 2



Spermiogenesis

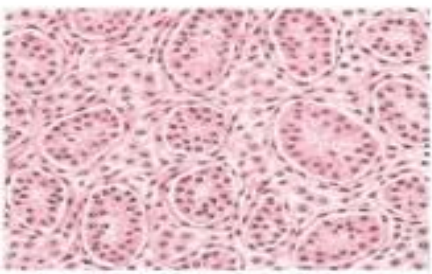


Mature spermatozoon

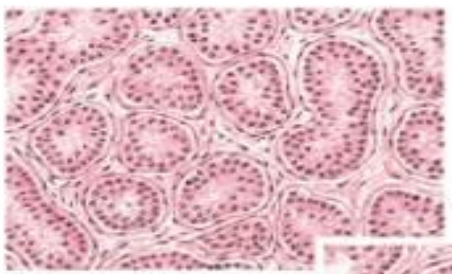


▼ Spermatogenesis showing successive stages in development.

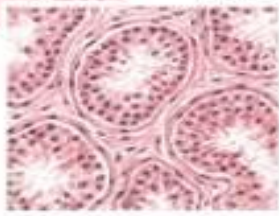
Neonatal testis



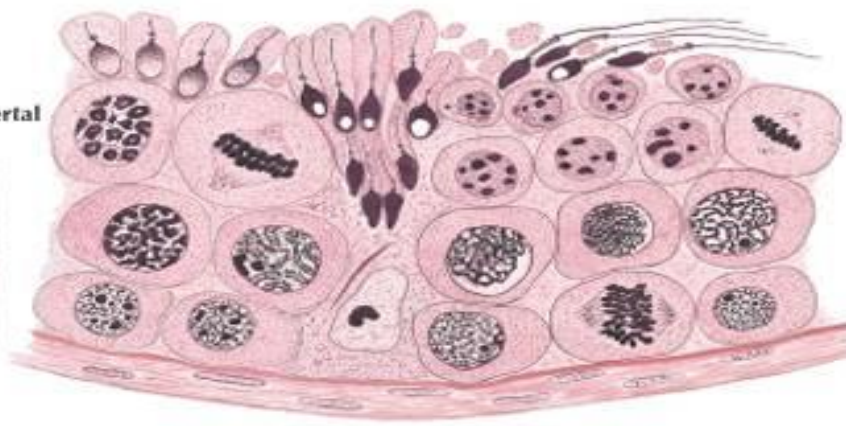
Infantile testis



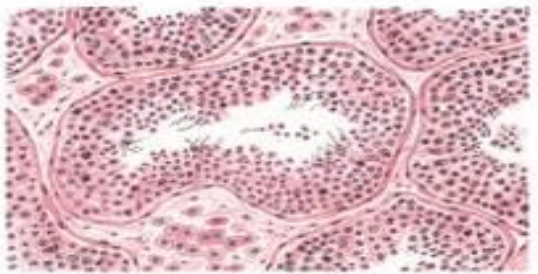
Late prepubertal testis



Seminiferous epithelium

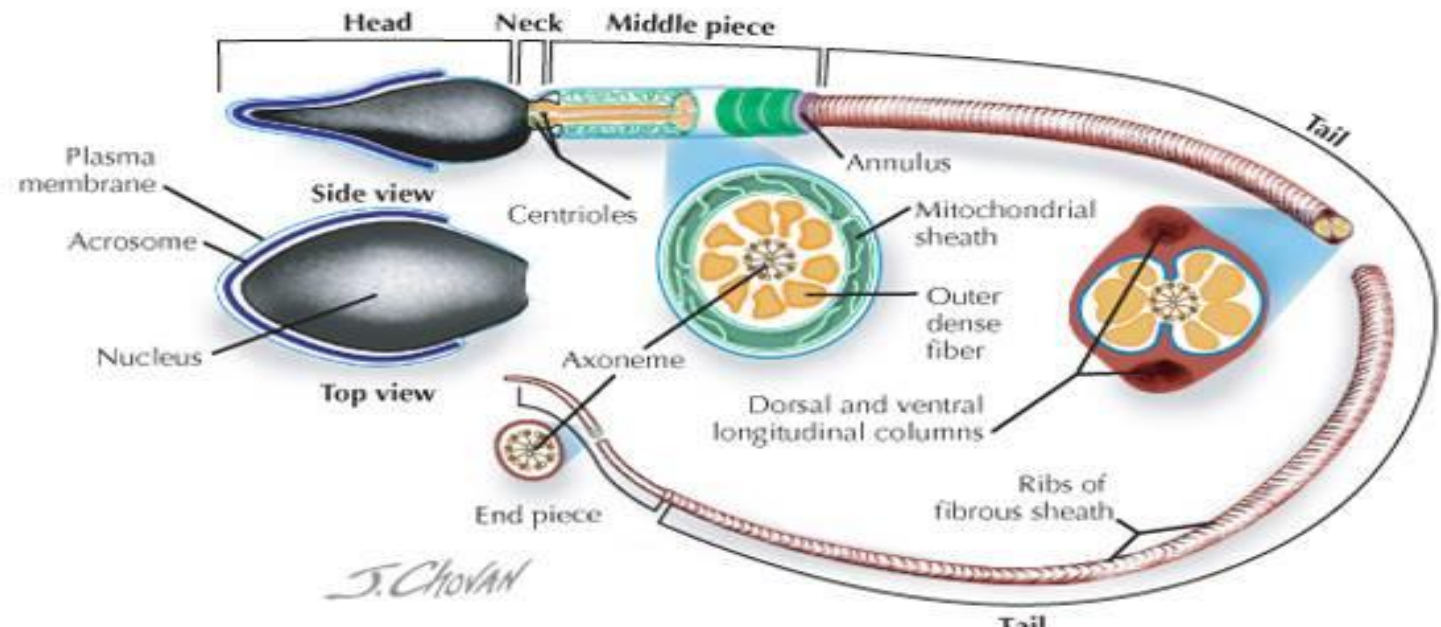


Adult testis



F. Netter M.D.

▼ Mature spermatozoon.



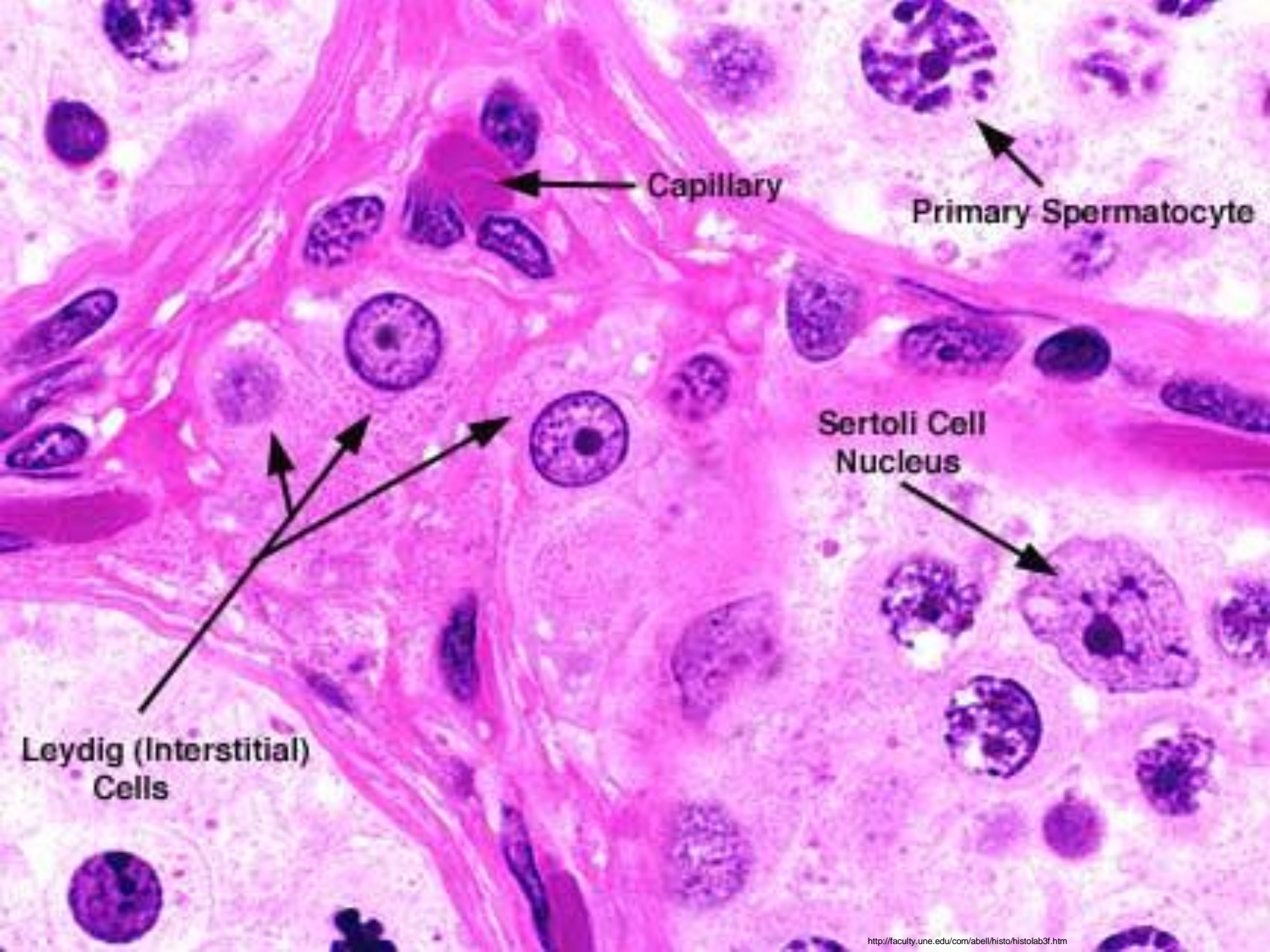
Sperm maturation

- immediately after ejaculation sperms are not capable of fertilization (*fertilisatio*)
- **capacitation – 7 hours**
 - cover removed from the acrosomal surface
- acrosomal reaction
 - hyaluronidase + acrosine enable the sperm to pass through the corona radiata and zona pellucida of oocyte
- **viability 48 hours**
- **viability of oocyte only 24 hours**

Interstitial connective tissue

Textus connectivus intertubularis

- **Leydig cells**
(*Endocrinocytus interstitialis*)
 - **testosterone**
 - active mainly in weeks 8-12 of intrauterine life (influenced by HCG)
 - principle importance for male genital organs differentiation
 - again active from puberty (influenced by LH)
 - binding to ABP enables its high concentration within tubuli seminiferi → optimal spermiogenesis
 - secondary sex characteristics
 - Reinke's cytoplasmic crystals
- collagen, capillaries, fibroblasts, mast cells, macrophages

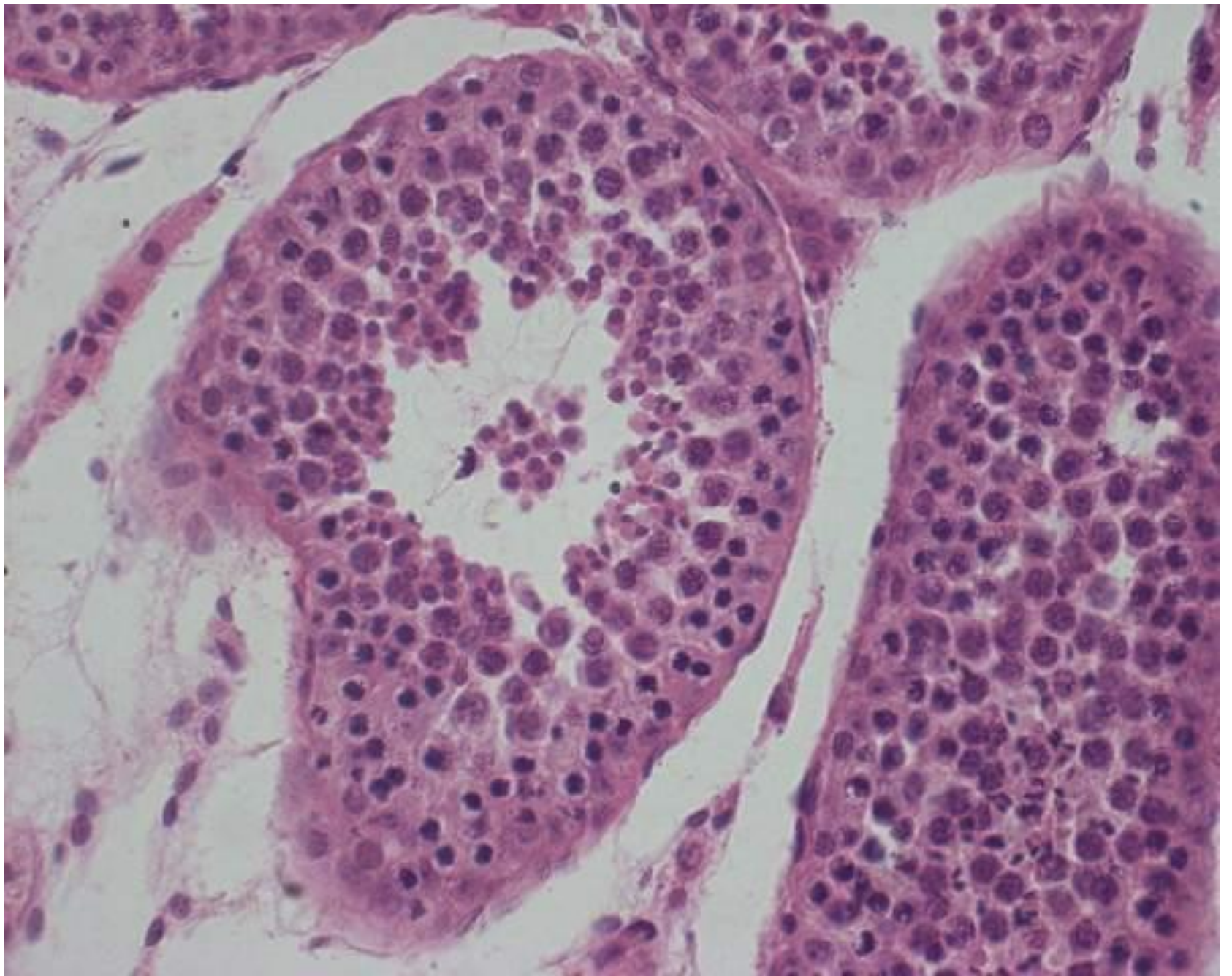


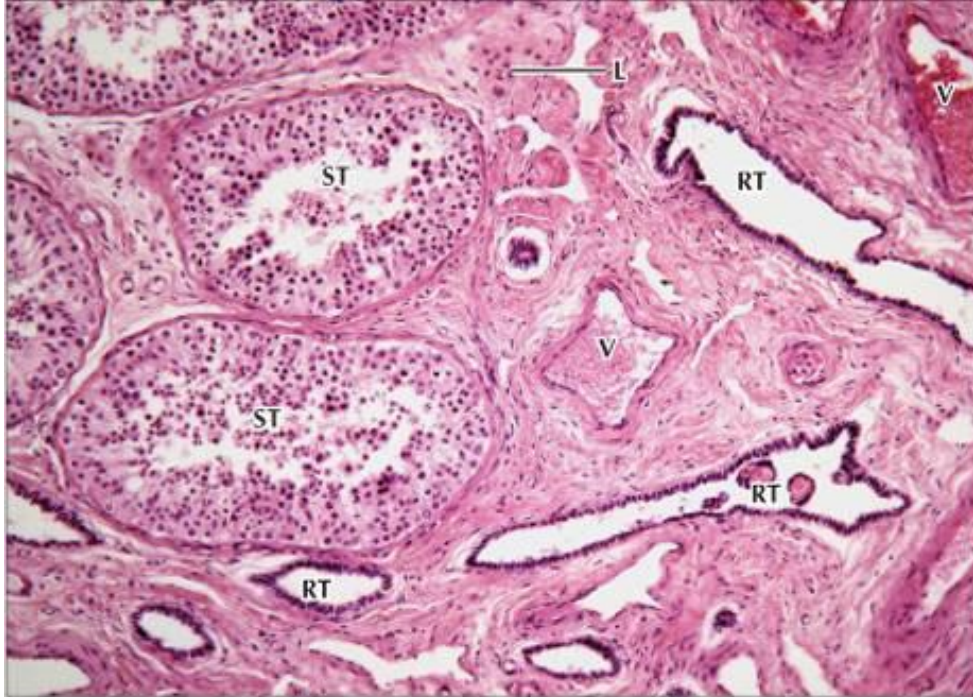
Capillary

Primary Spermatocyte

Sertoli Cell
Nucleus

Leydig (Interstitial)
Cells





◀ **LM of the mediastinum testis.** Seminiferous tubules (ST) are embedded in a stroma rich with vessels (V). A network of branching channels constitutes the rete testis (RT). Clusters of Leydig cells (L) occupy angular spaces in the stroma. 115x. H&E.

▶ **LM of a seminiferous tubule in transverse section.** A capsule (arrows) surrounds seminiferous epithelium. Spermatogonia (Sg) are at the tubule base; large spermatocytes (Sp) and smaller spermatids (S) are closer to the lumen. Pillar-shaped Sertoli cells (SC) are interspersed with germ cells. A clump of Leydig cells is in adjacent stroma. 450x. H&E.



Excretory genital ducts – testis

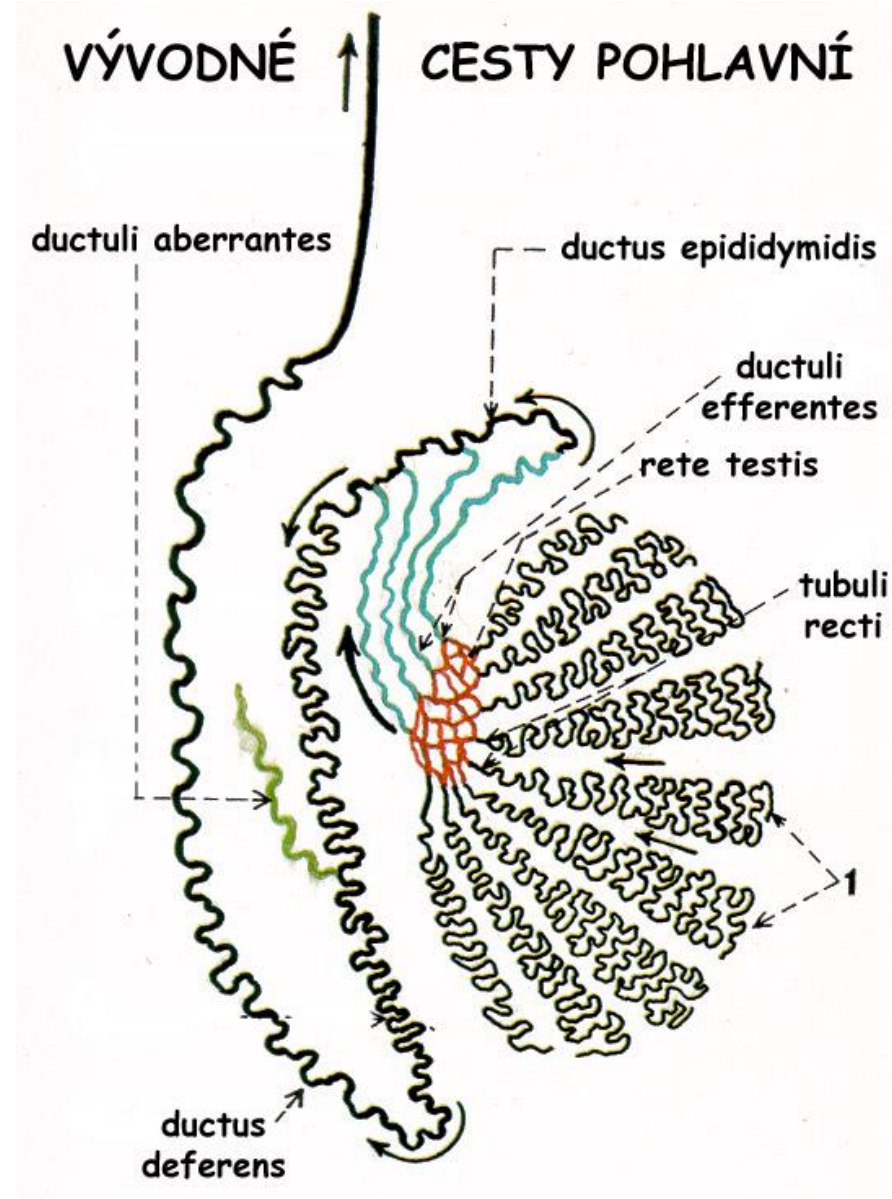
Mediastinum testis

- **tubuli recti testis**

- simple cuboid epithelium
- Sertoli cells at beginning
- lamina propria

- **rete testis**

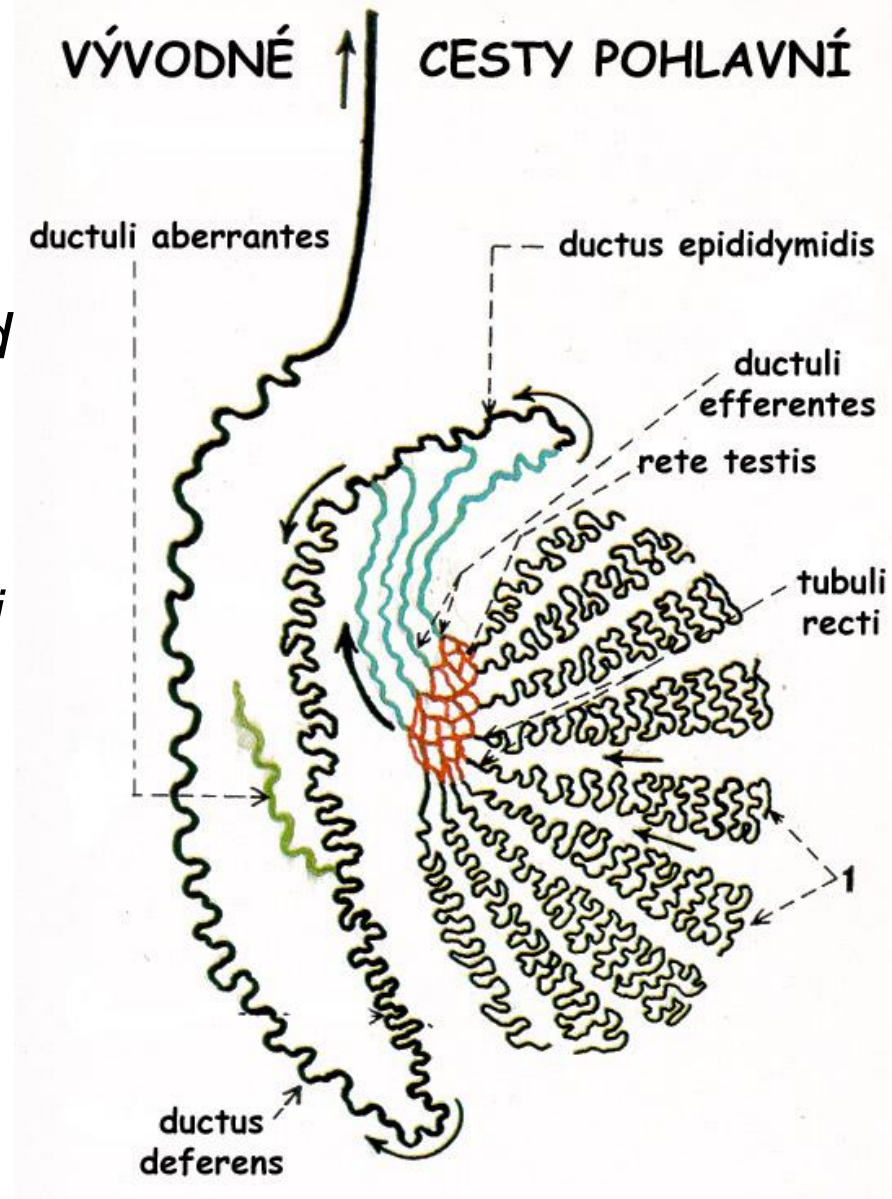
- simple cuboid to low columnar epithelium
 - 1 kinocilium, many microvilli
- lamina propria



Excretory genital ducts – epididymis

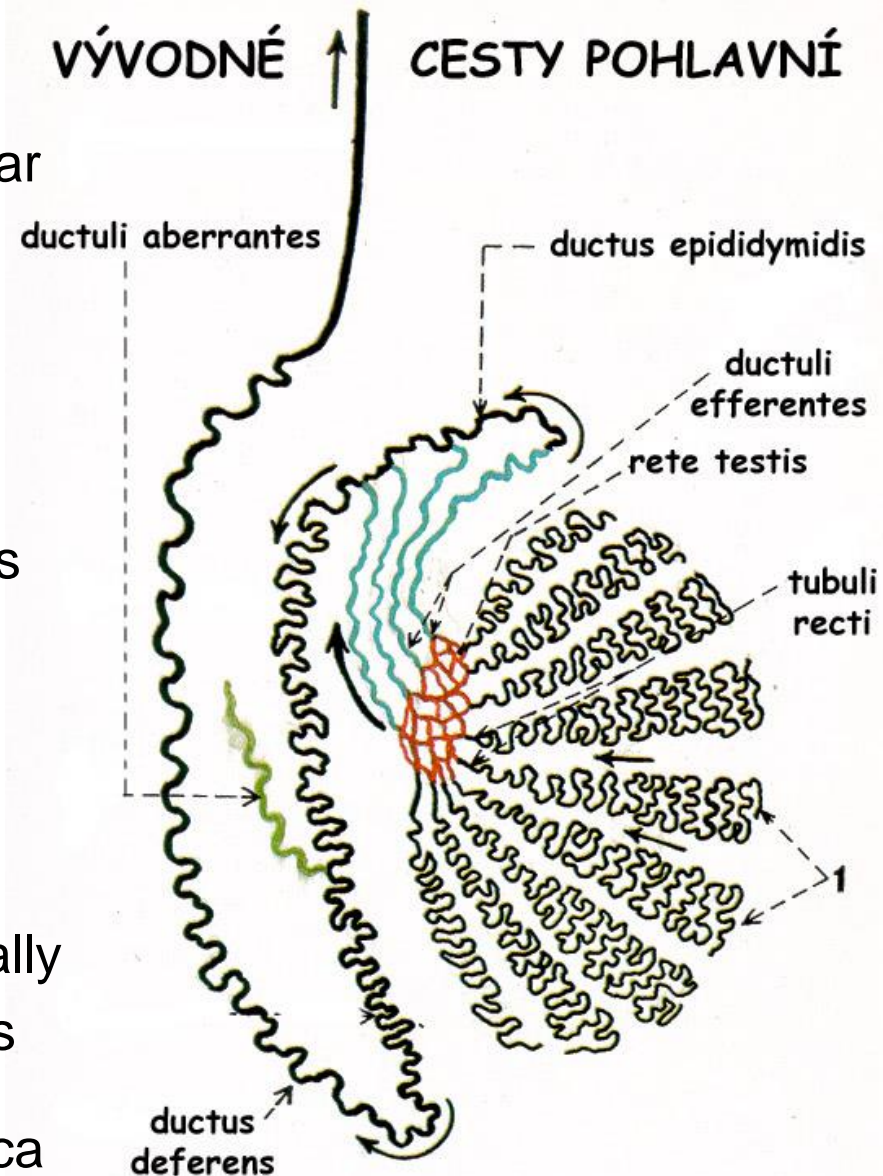
- **ductuli efferentes testis**

- simple to double-row pseudostratified cuboid to columnar epithelium (*sinusoid relief*)
 - *kinocilia – epitheliocyti columnares ciliati*
 - *microvilli – epitheliocyti cuboidei microvillosi*
- 12-20 canals (15-20 cm)
- lamina propria
- stratum musculare
 - 1 layer of smooth muscle cells
 - externally elastic fibres
- tunica adventitia



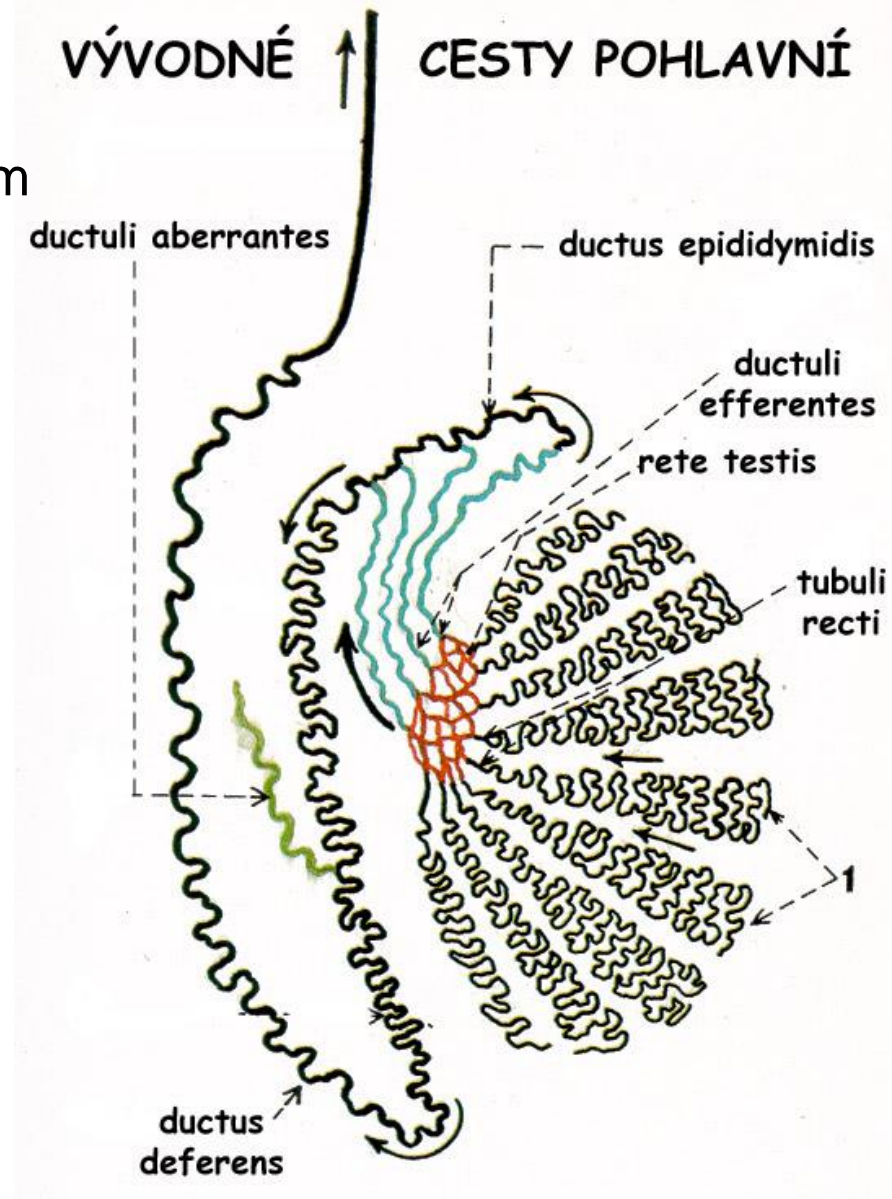
Excretory genital ducts – epididymis

- **ductus epididymidis**
 - pseudostratified double-row columnar epithelium
 - 6m long many times coiled
 - **principal cells**
 - stereocilia
 - H⁺-ATPase (pH 6.5) – inhibition
 - nutrition of sperms (glykoproteins and glycerolphosphochole)
 - phagocytosis
 - hemato-epididymal barrier
 - SDF – decapacitation
 - basal cells – small and round
 - halo cells – immune function, basally
 - light and slim cells – endocytosis of proteins
- lamina propria, stratum musculare, tunica adventitia



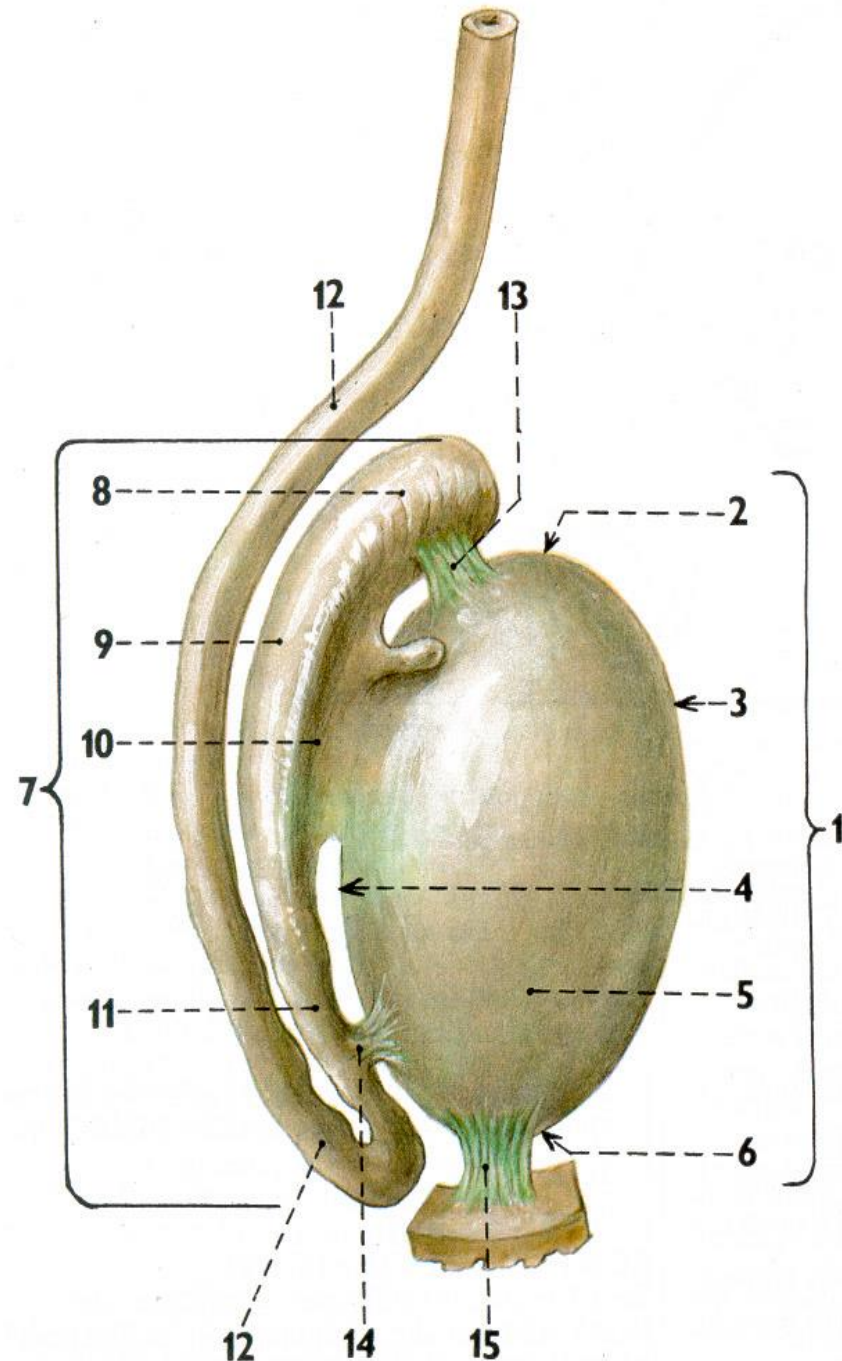
Excretory genital ducts – epididymis

- **ductus deferens**
 - pseudostratified columnar epithelium (sometimes with nuclei in 2 rows)
 - with stereocilia
 - thick tunica muscularis
- **ampulla ductus deferentis**
 - simple columnar epithelium (sometimes with nuclei in 2 rows)
 - one layer of plexiform tunica muscularis
- **ductus excretorius**
 - simple columnar epithelium (sometimes with nuclei in 2 rows)
 - two layers of tunica muscularis
- **ductus ejaculatorius**
 - no tunica muscularis

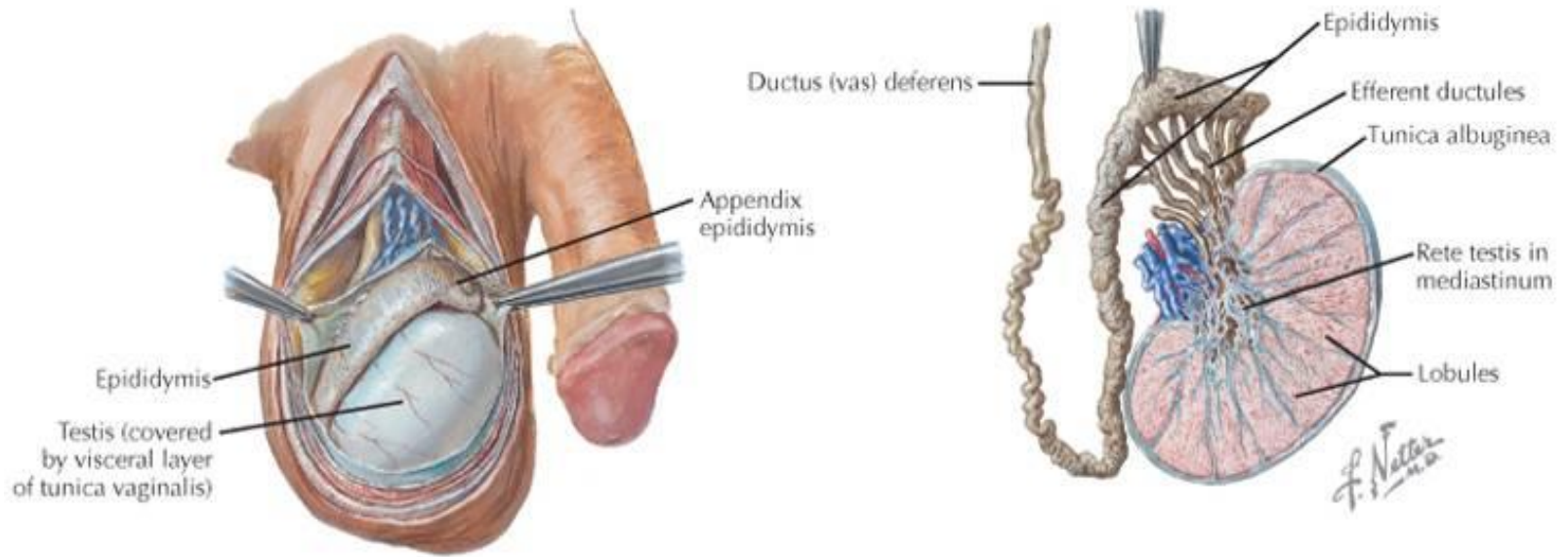


Epididymis

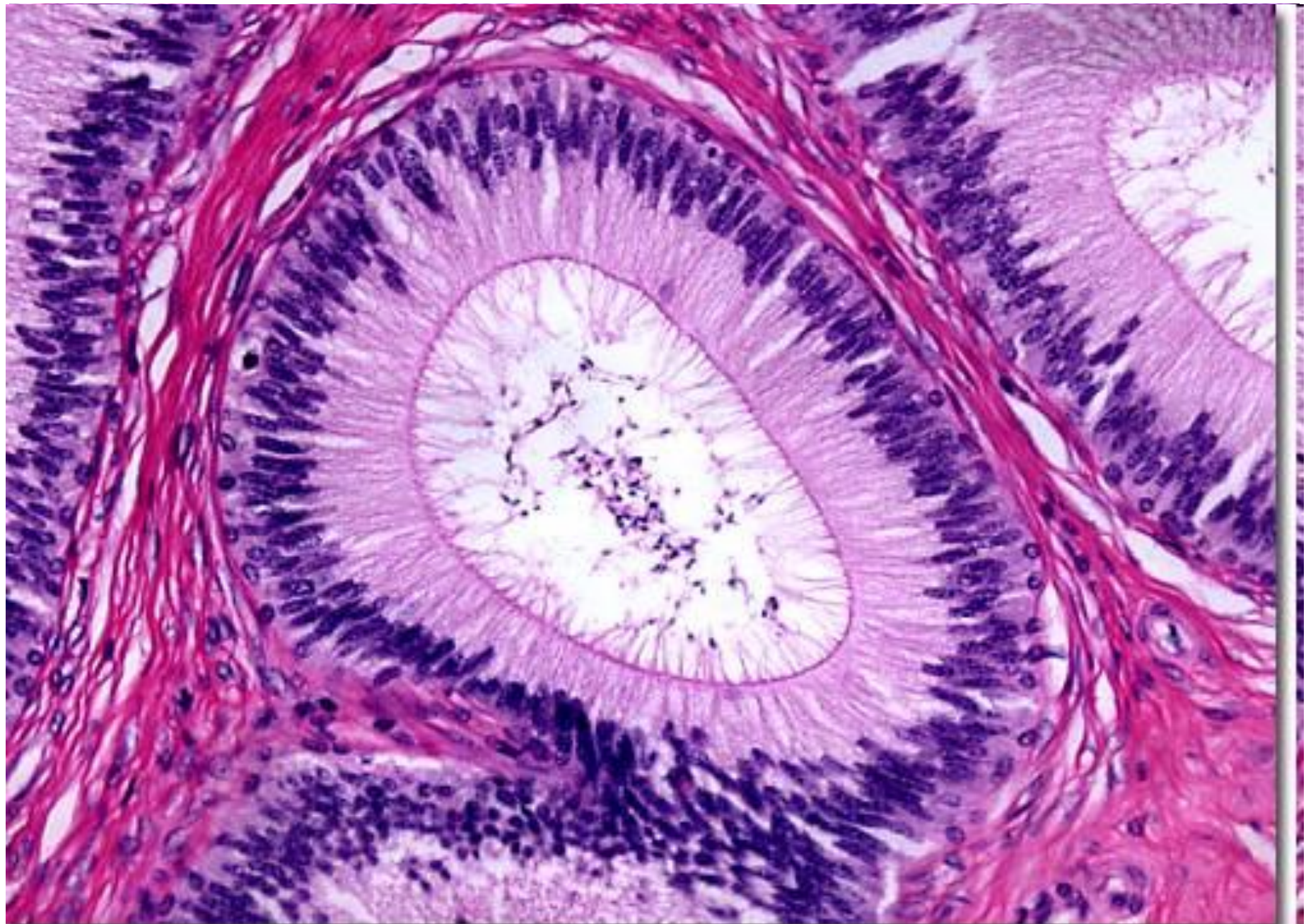
- external features
 - caput, corpus, cauda
- internal feature
 - ductus epididymidis
 - lobuli epididymidis
- ligaments
 - lig. epididymidis superius + inferius

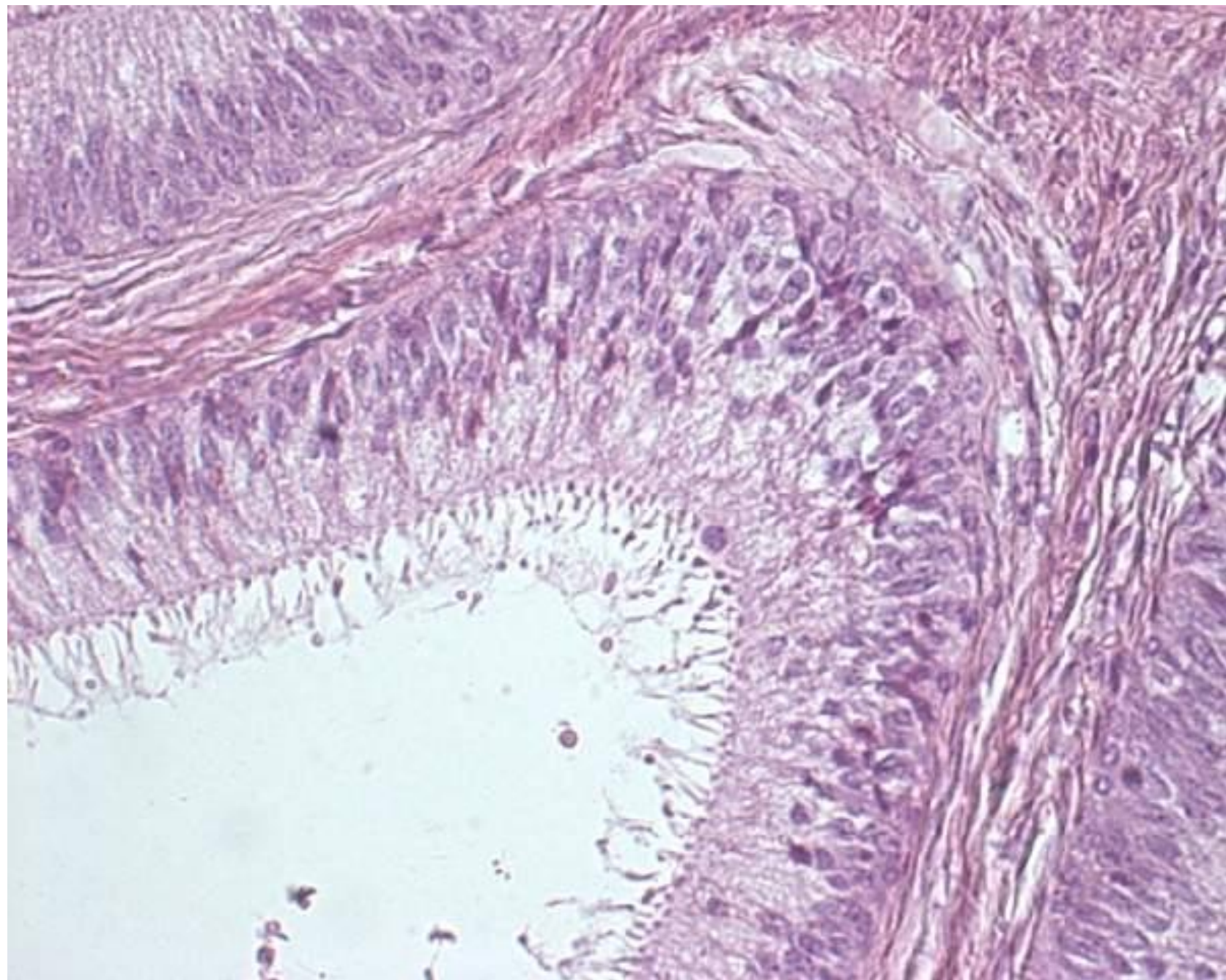


▼ Testis, epididymis & vas deferens.



◀ **LM of the epididymis on the posterior pole of the testis.** The crescent-shaped epididymis consists mainly of a highly tortuous duct held together by loose connective tissue and covered by the visceral tunica vaginalis (**arrows**). Several profiles of spermatozoa are seen in the lumen. A dilated cyst-like structure (*) in the head of the epididymis corresponds to the appendix epididymis, a mesonephric duct remnant. A thick tunica albuginea covers the surface of the testis. 20 \times , H&E.





Testis + epididymis

arterial supply

- aorta abdominalis

→ **a. testicularis**

branches enter the lobules from periphery (tunica vasculosa)

auxilliary arterial supply

- a. iliaca interna

→ a. umbilicalis

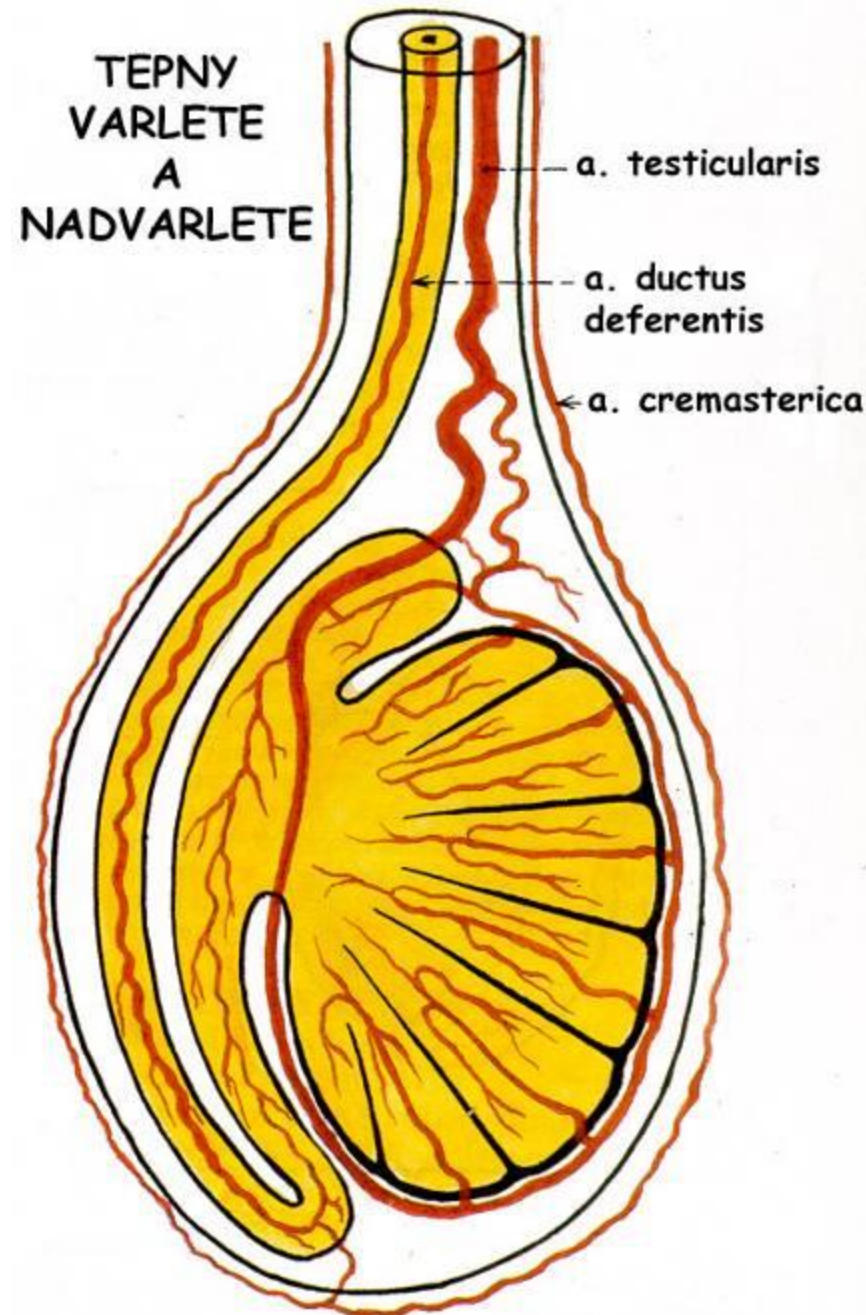
→ **a. ductus deferentis**

- a. iliaca externa

→ a. epigastrica inf.

→ **a. cremasterica**

mutual anastomoses

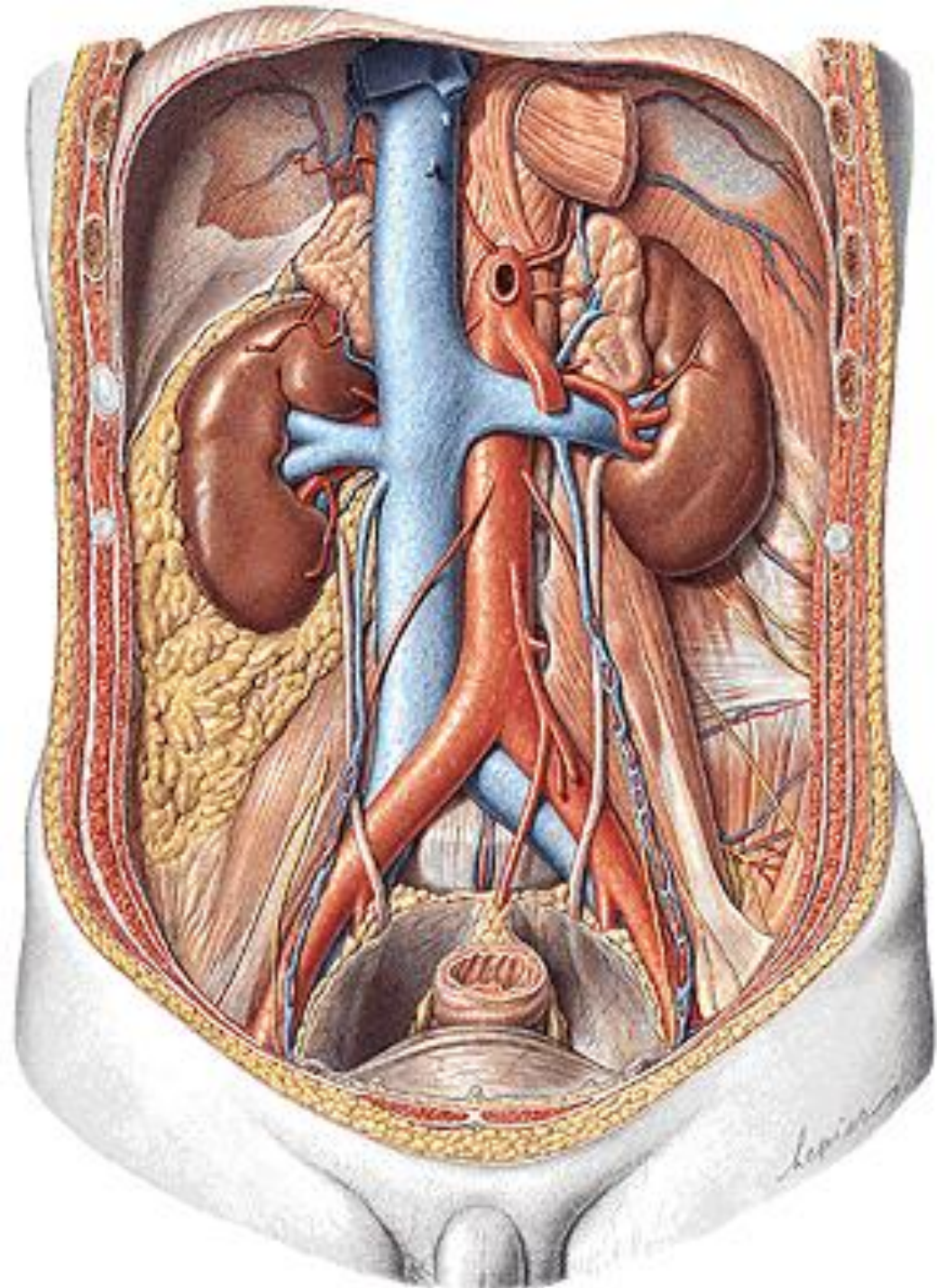


Testis + epididymis

venous and lymph drainage, innervation

all form/to the level of **L2**

- Veins:
 - rete testis → **plexus pampiniformis** → vv. testiculares → v. cava inf. (dx.) / v. renalis (sin.)
- Lymph:
 - **nodi lymphoidei lumbales**
- Nerves:
 - plexus testicularis
 - *sympathetic* fibers from plexus coeliacus + intermesentericus
 - *parasympathetic* fibers from **n. vagus**



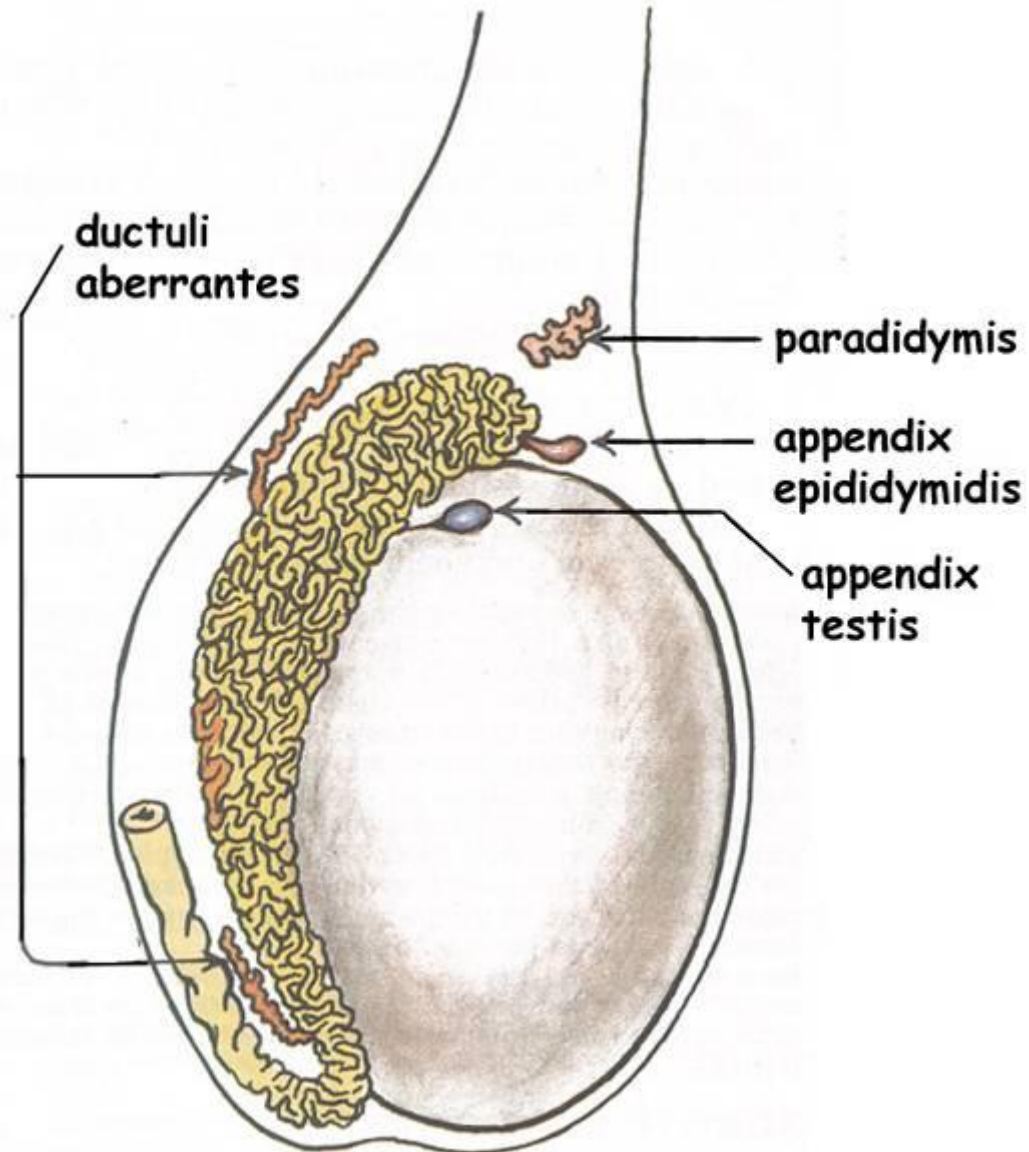
Developmental rudiments

from tubuli mesonephrici

- paradidymis (organ of *Giraldes*)
- ductuli aberrantes (sup. + inf.)
- appendix epididymidis

from Müller's duct

- appendix testis



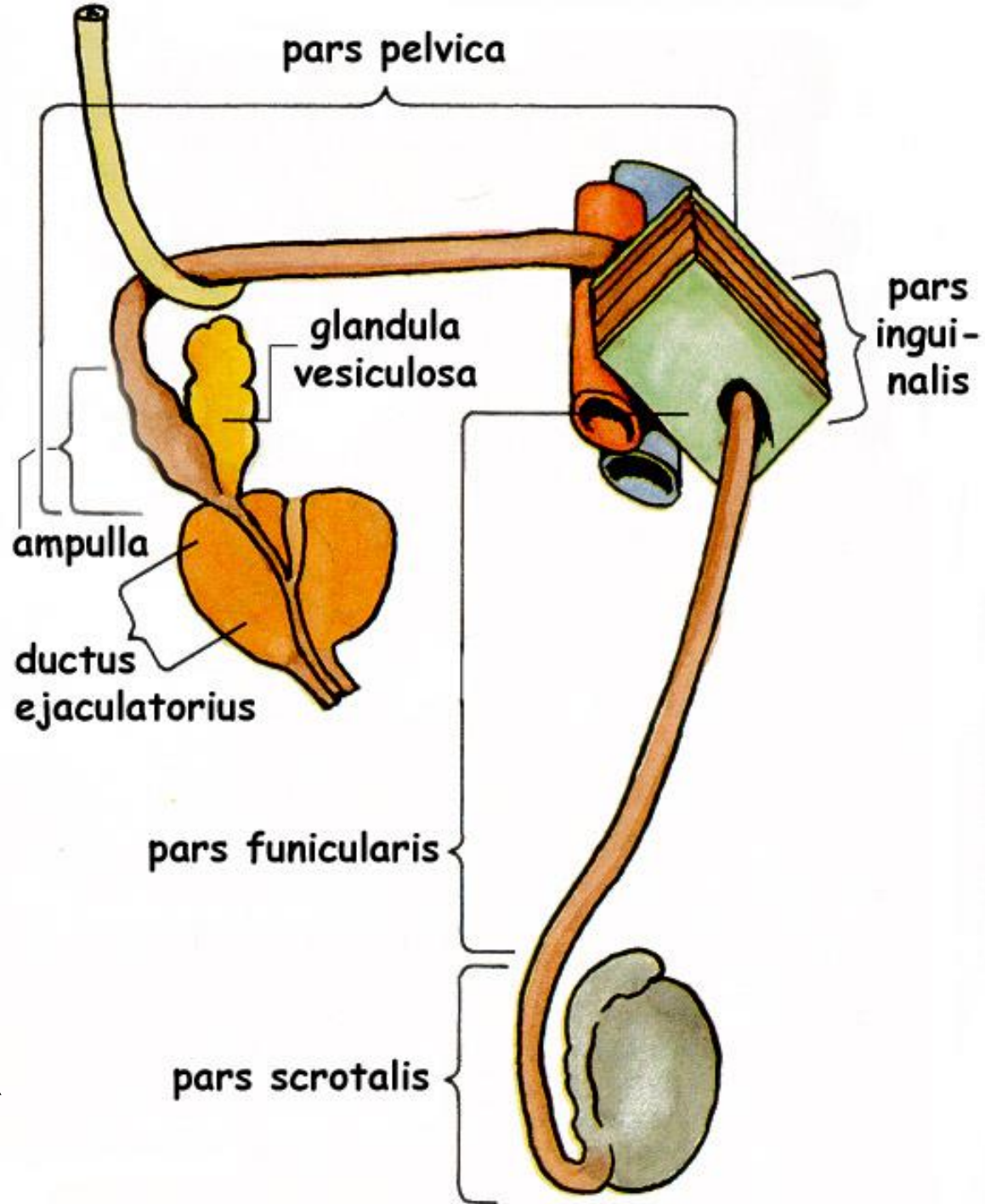
Ductus deferens

40 cm x 3 mm
lumen 1.5 mm

- pars scrotalis
- pars funicularis
- pars inguinalis
- pars pelvica
 - ampulla d.d.

crossing: ventral to

- vasa iliaca externa
- ureter

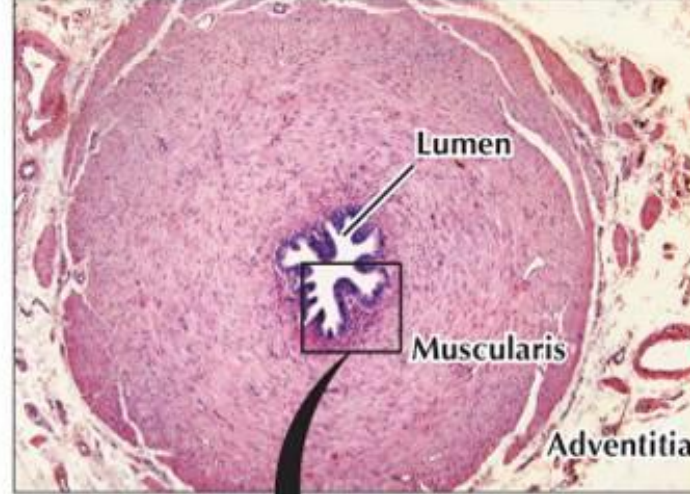
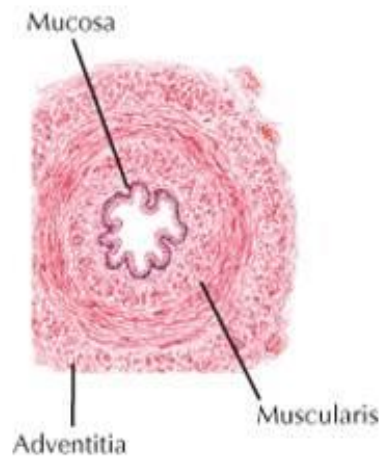


Ductus deferens

(incorrect: Vas deferens)

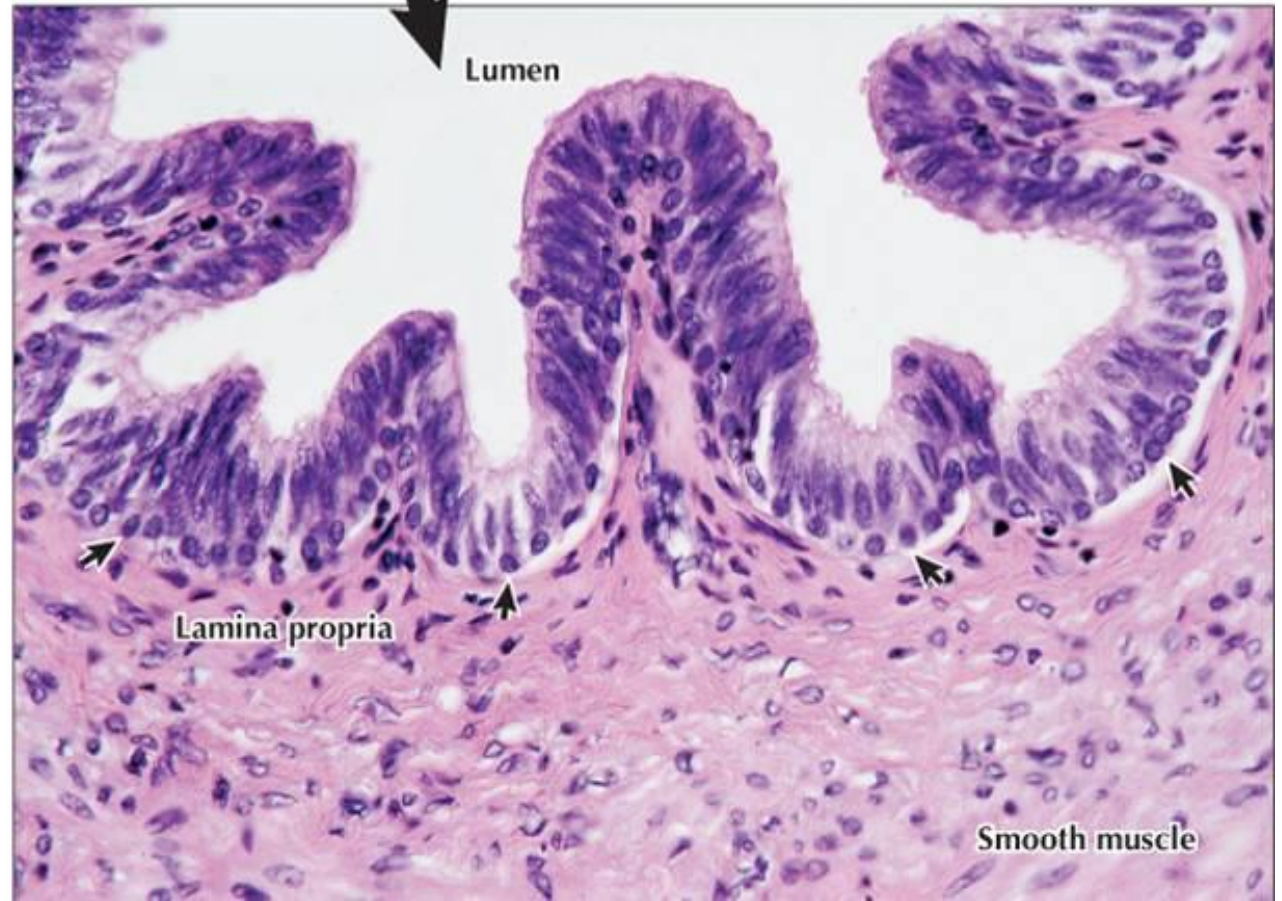
- tunica mucosa
 - pseudostratified epithelium (nuclei in two rows) with stereocilia
 - longitudinal folds
 - crypts in ampulla
- tunica muscularis
 - thick, 3 layers (2 longitudinal and middle one circular)
 - tough as goose quill
- tunica adventitia

emission = transport of sperms to the colliculus seminalis prostatae (to the end of pure excretory genital ducts)



◀ **LM of the ductus deferens in transverse section.** Folds of mucosa produce a stellate lumen. Around the mucosa is a prominent three-layer coat of tightly spiraled smooth muscle, the muscularis. Blood vessels, nerves, and lymphatics travel through an adventitia of loose connective tissue that covers the ductus externally. 35 \times . H&E.

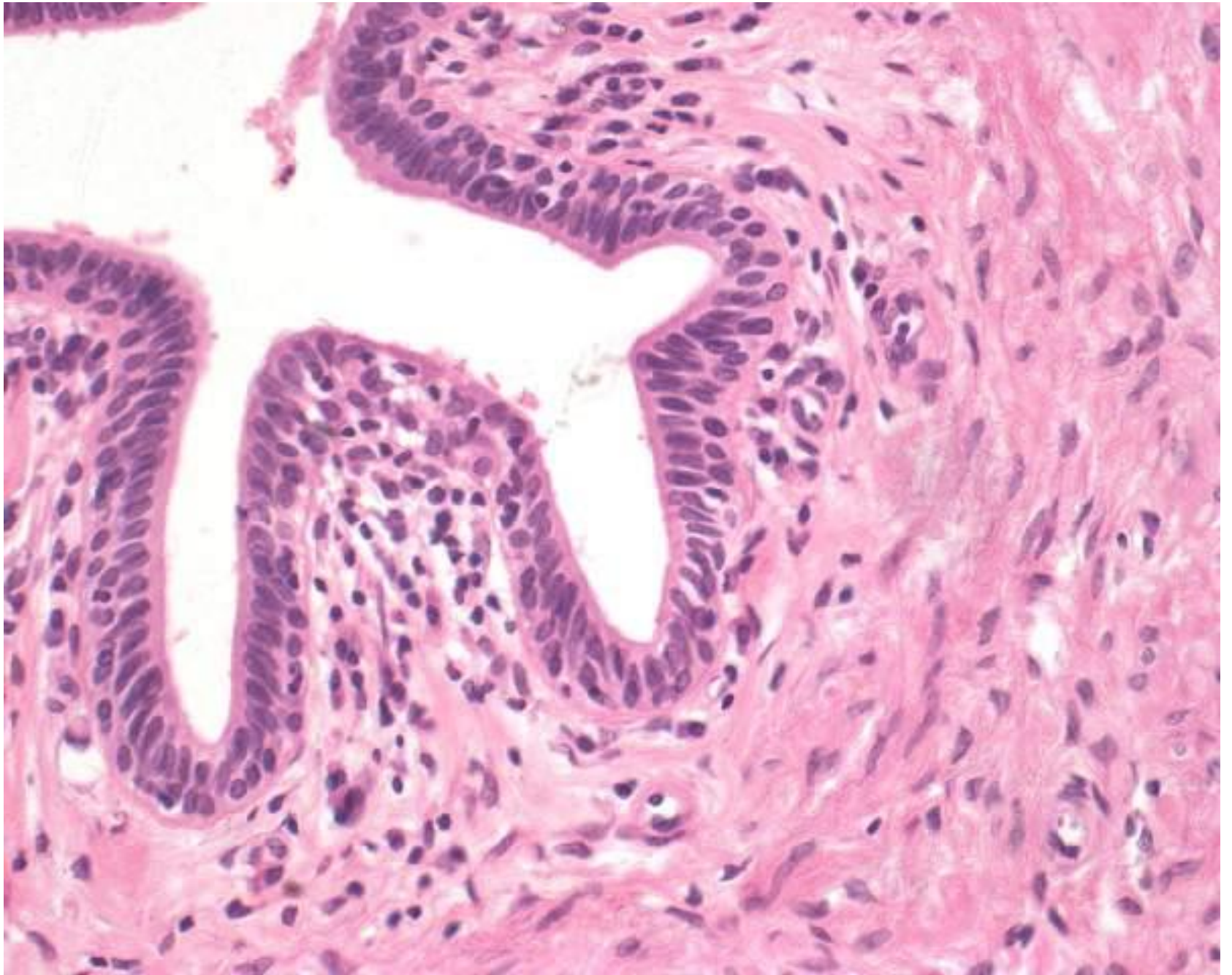
▶ **Higher magnification LM of the mucosa of the ductus deferens.** The highly folded mucosa consists of pseudostratified columnar epithelium, which closely resembles that of the epididymis. Columnar cells with apical stereocilia and a row of small, round basal cells (**arrows**) are seen. The mucosal folds are due to contraction of underlying smooth muscle. 285 \times . H&E.



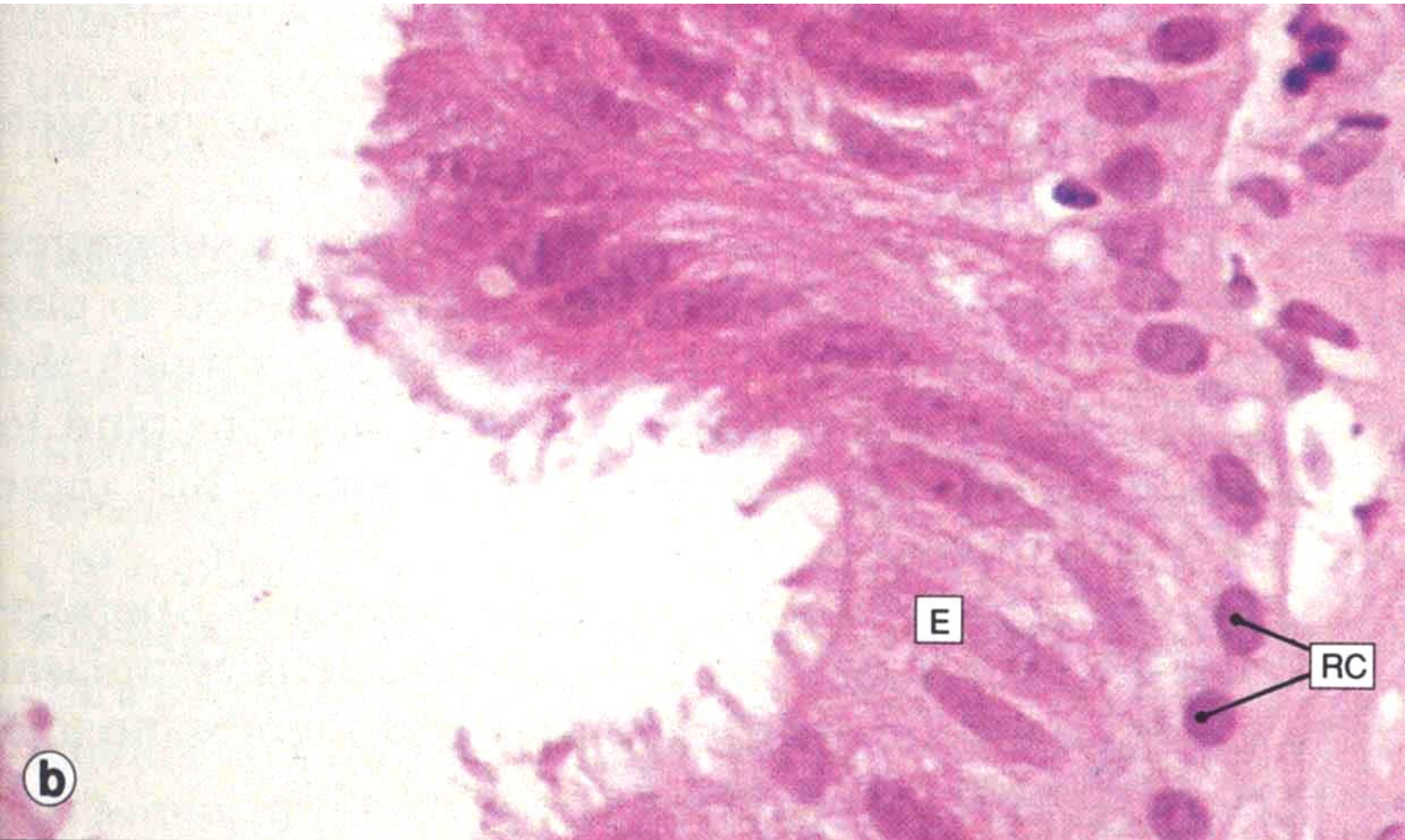
Ductus deferens

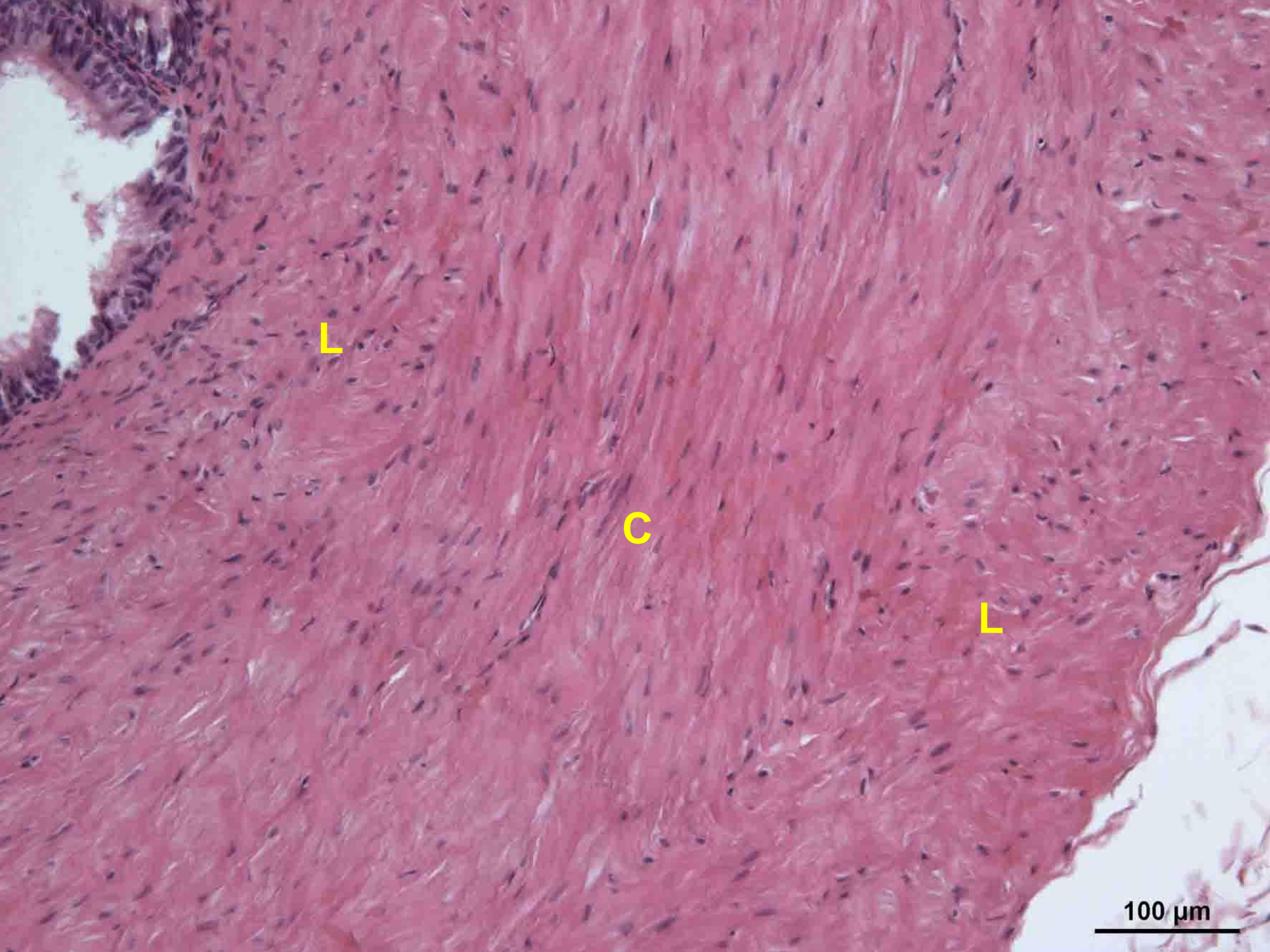


500 μ m



Ductus deferens





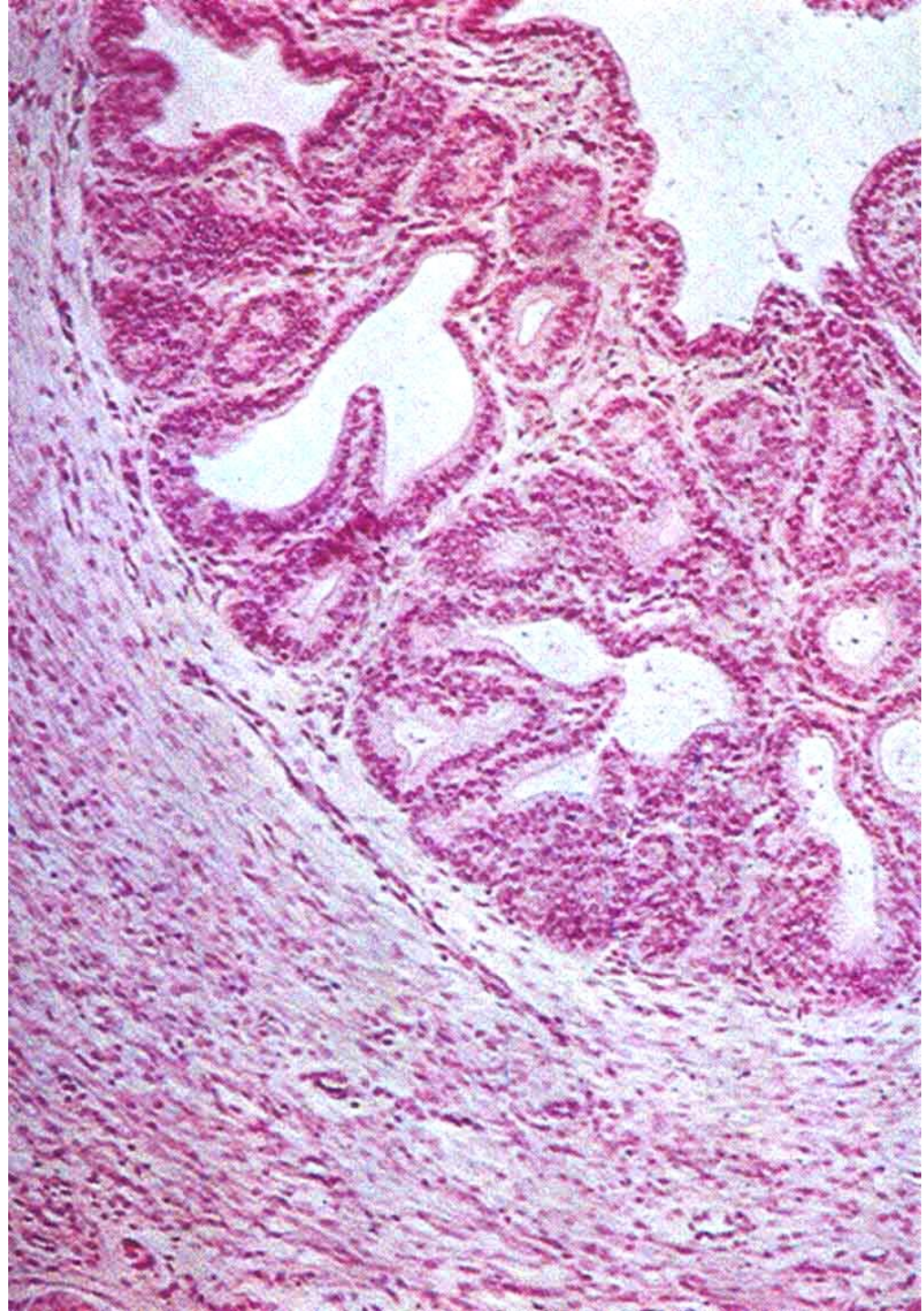
L

C

L

100 μ m

Ampulla ductus deferentis



Ductus deferens *supply*

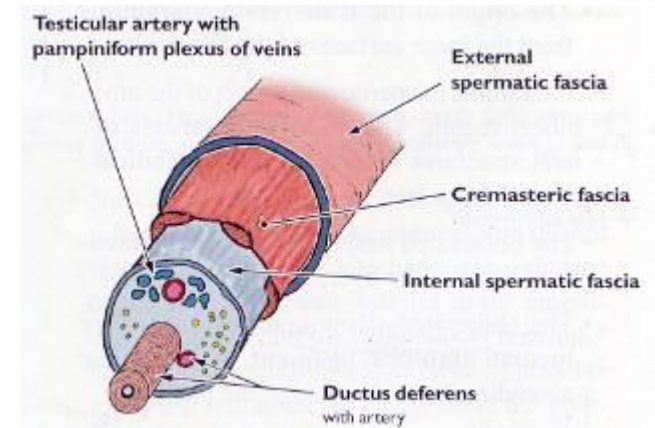
- Arteries:
 - a. iliaca int. → a. umbilicalis → **a. ductus deferentis**
- Veins:
 - plexus pampiniformis, plexus venosus vesicalis
- Lymph:
 - n.l. iliaci ext. + int.
- Nerves:
 - plexus deferentialis

Spermatic cord

Funiculus spermaticus

covers

- tunica dartos
- fascia spermatica externa
- m. cremaster cum fascia cremasterica
- fascia spermatica interna



<http://academic.amc.edu/martino/grossanatomy/site/Medical/Lab%20Manual/Reproductive/answers/perineum1.htm>

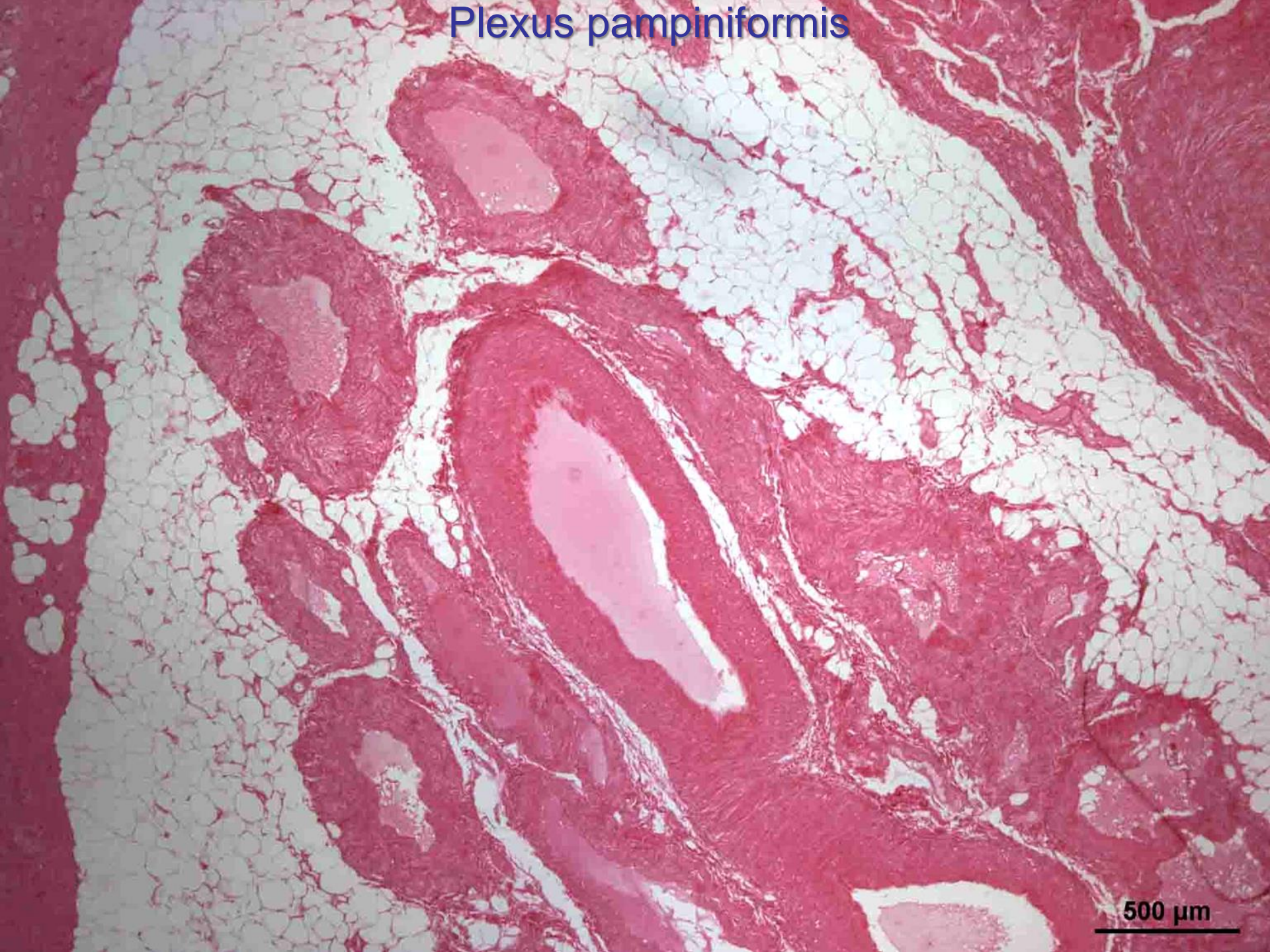
*derivates of abdominal wall formed by
descensus testis*

Spermatic cord *contents*

- a. ductus deferentis (← a. iliaca int.)
- a. testicularis (← aorta abdominalis)
- plexus pampiniformis (venous plexus) → v. cava inf.
- ductus deferens
- a. et v. cremasterica (← a. epigastrica inf.)
- vestigium processus vaginalis peritonei
- plexus deferentialis et testicularis (= nervové pleteně)
- lymph vessels (along veins)



Plexus pampiniformis



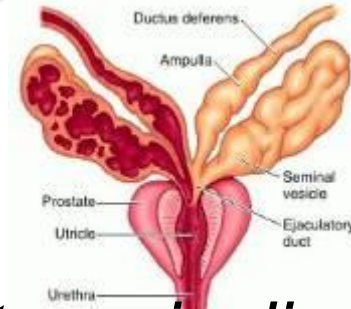
500 μ m

Seminal gland

Glandula vesiculosa / seminalis

(incorrect: Seminal vesicles; Vesiculae seminales)

- 5 x 2 cm
- behind urinary bladder
- in contact with peritoneum – *excavatio rectovesicalis*
- one coiled duct (*ductus excretorius*) – 10-15 cm x 3-4 mm – with rich secondary and tertiary folds (*plicae mucosae*) → *ductus ejaculatorius*
- simple columnar epithelium (sometimes with nuclei in 2 rows), no stereocilia
- tunica muscularis: 2 thin layers
 - inner circular and outer longitudinal
- secretion: 70% of ejaculate, pH 7.6
 - **fructose** + proteins + prostaglandin + citrate + semenogelin (transient higher viscosity of sperms)

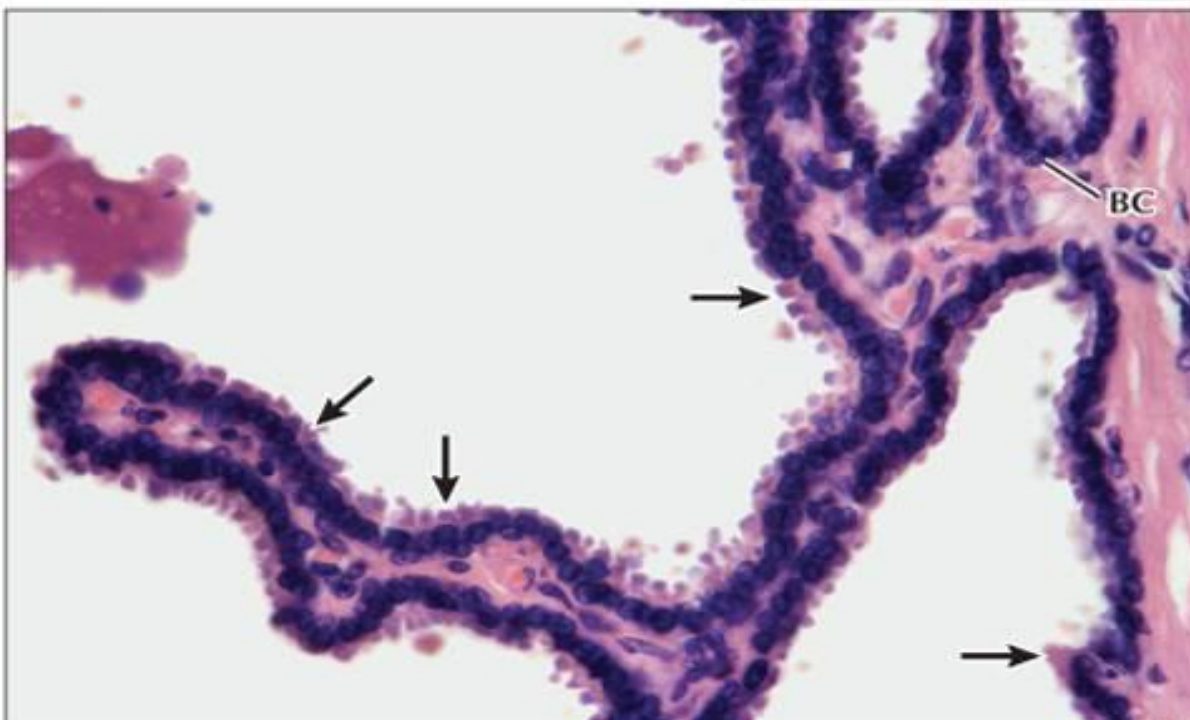




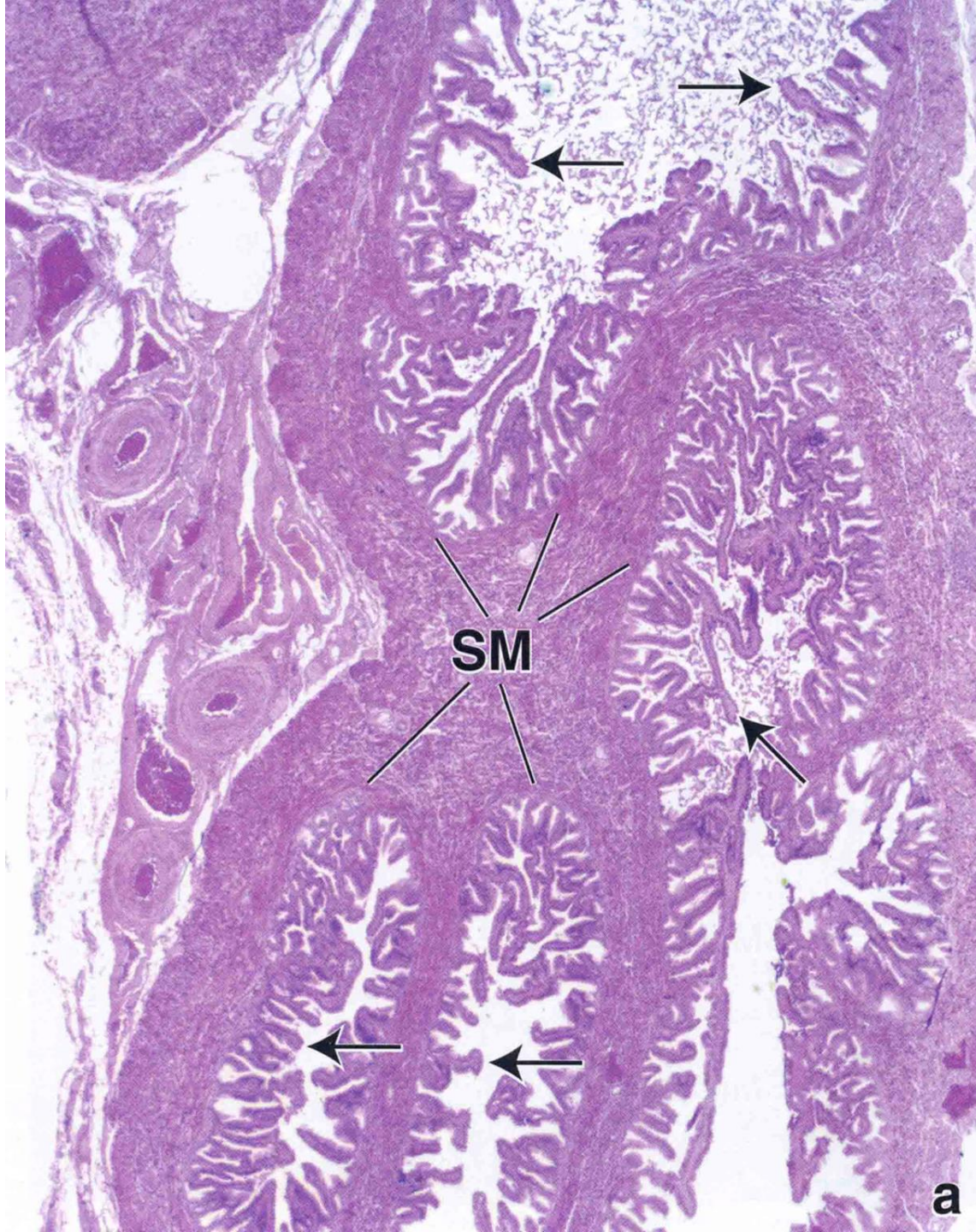
▲ **LM of the seminal vesicle.** The gland's mucosal folds are complex, and its wall has smooth muscle (**SM**) arranged tightly in inner circular and outer longitudinal layers. Flocculent eosinophilic material fills the lumen. 50 \times . H&E.



▲ **Higher magnification LM of the mucosa of the seminal vesicle.** The honeycombed mucosa has an epithelium (**arrows**) composed of columnar cells and basal cells. Semen consists of spermatozoa formed in germinal epithelium of the testis and seminal fluid, the components of which are secreted by the excretory duct system and accessory glands. Most of this fluid is produced in seminal vesicles. 280 \times . H&E.



◀ **High-magnification LM of the mucosa of the seminal vesicle.** The epithelium is usually pseudostratified, but it may be simple columnar in places. Its height varies with age, phase of secretion, and hormonal influence. Columnar cells with eosinophilic, dome-shaped apical cytoplasm (**arrows**) are normally interspersed with small rounded basal cells (**BC**). 500 \times . H&E.



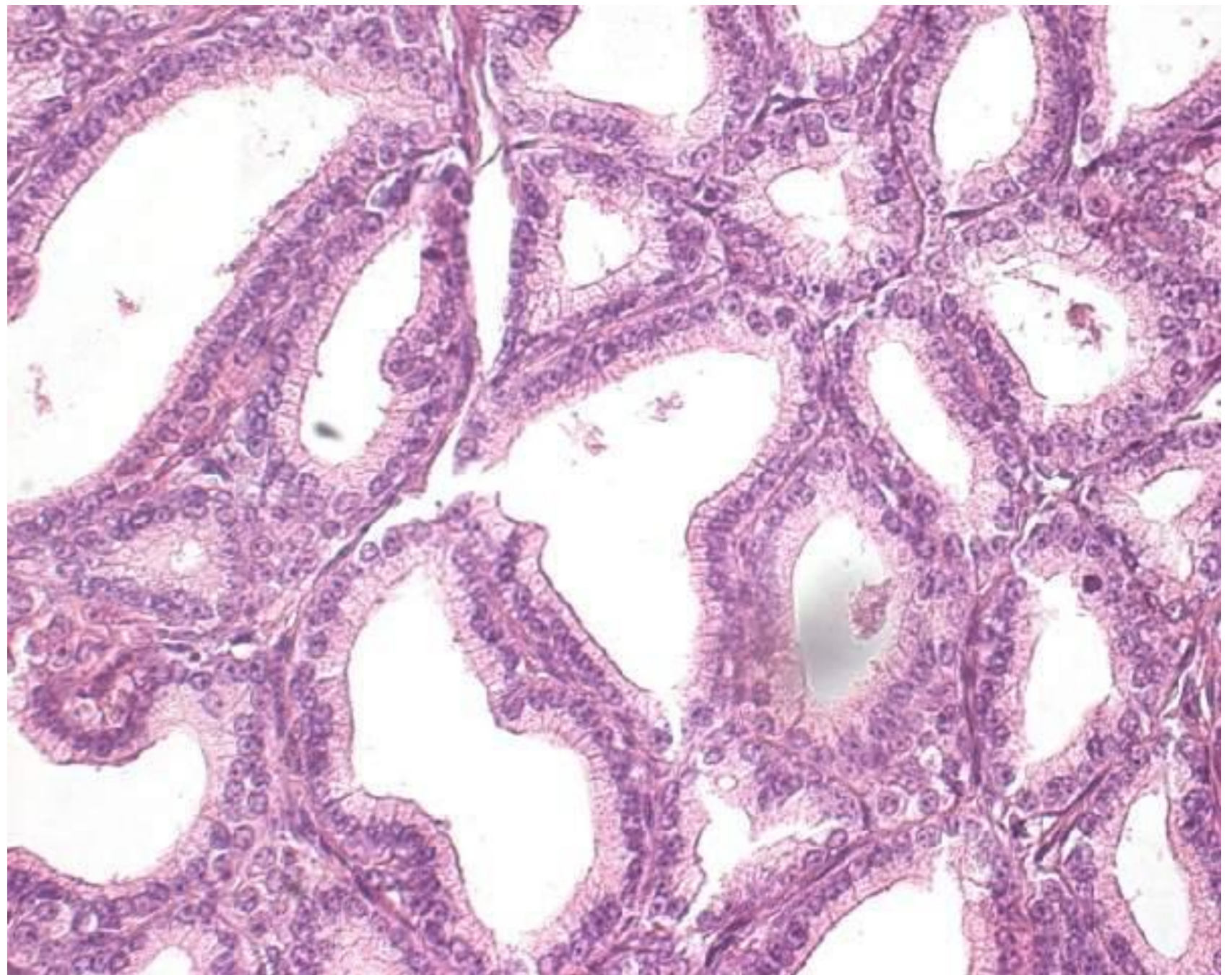
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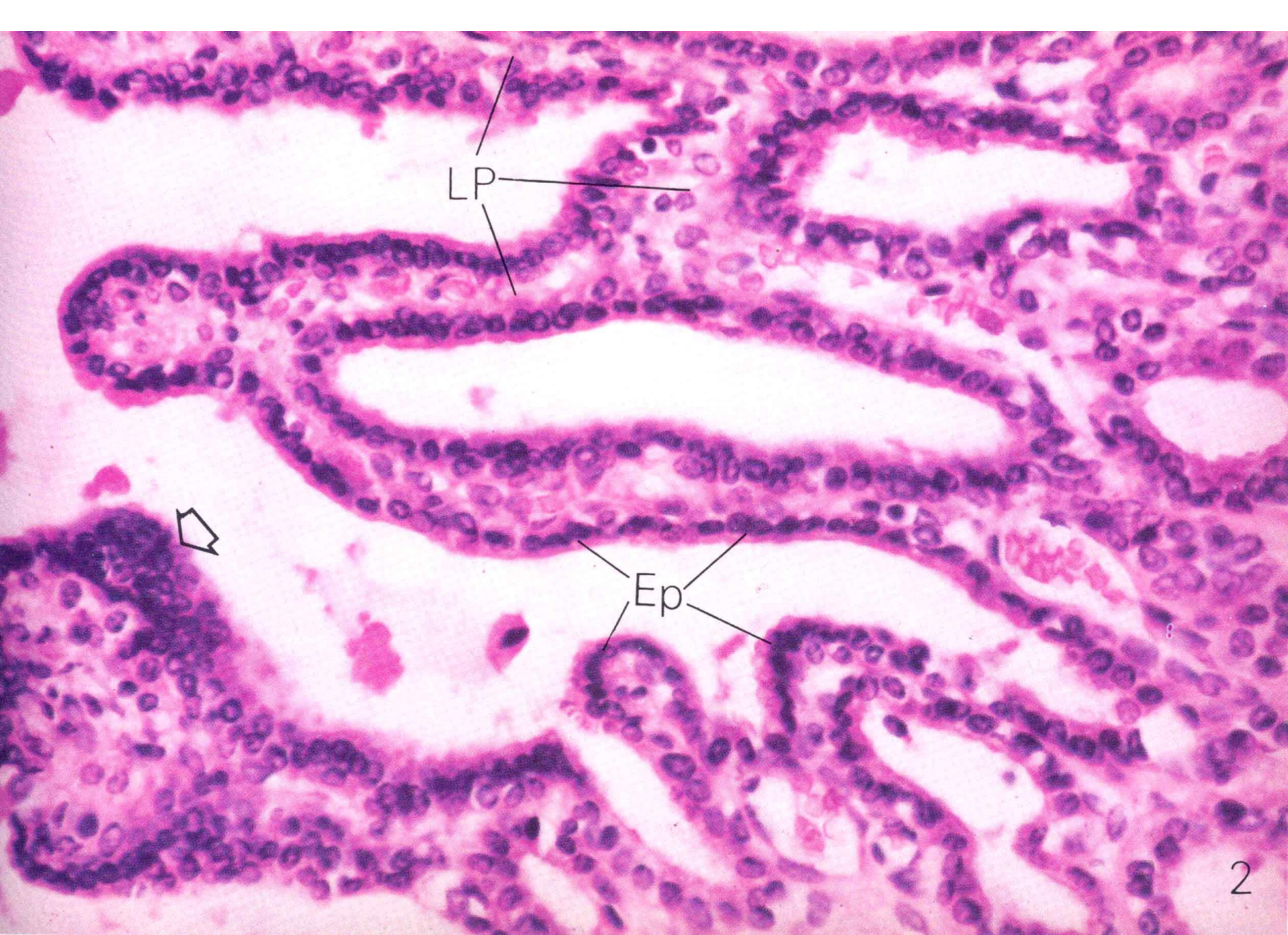


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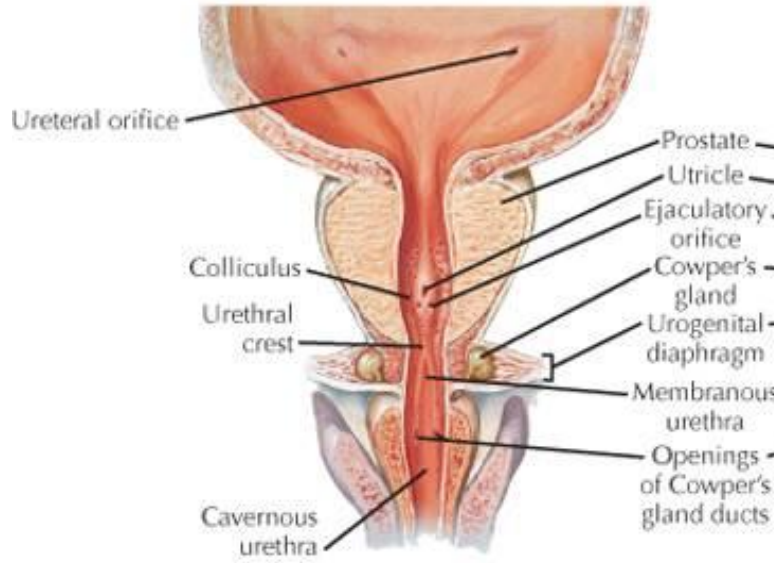
M



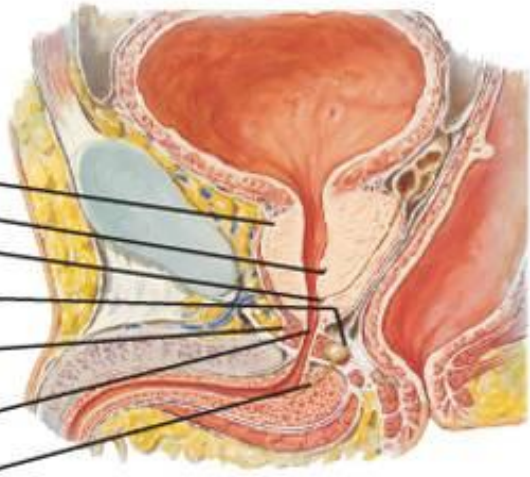




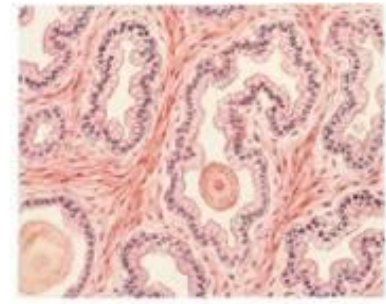
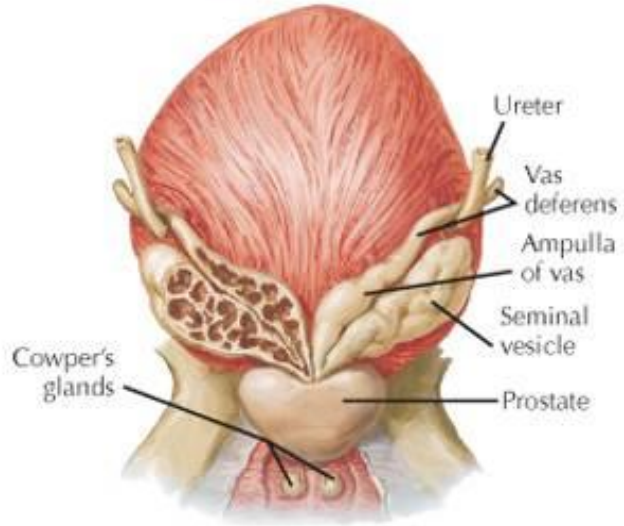
▼ Frontal section.



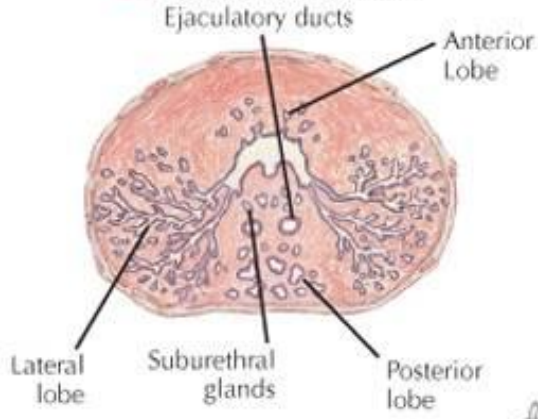
▼ Sagittal section.



▼ Posterior view.



▲ Histology of prostate.



▲ Cross section (schematic: at level of verumontanum).

F. Netter M.D.

Prostate = *Prostata*

- 20 g, dimensions 4 x 3 x 2 cm
- external features:
 - basis, apex, isthmus
 - facies anterior, posterior et inferolateralis dx.+sin.
- division:
 - lobi prostatae: dexter et sinister
 - lobulus inferiorposterior, inferolateralis, superomedialis, anteromedialis
 - lobus medius
- pars prostatica urethrae
 - pars proximalis et distalis
- ductus ejaculatorius
 - 2 cm long, 2 mm wide

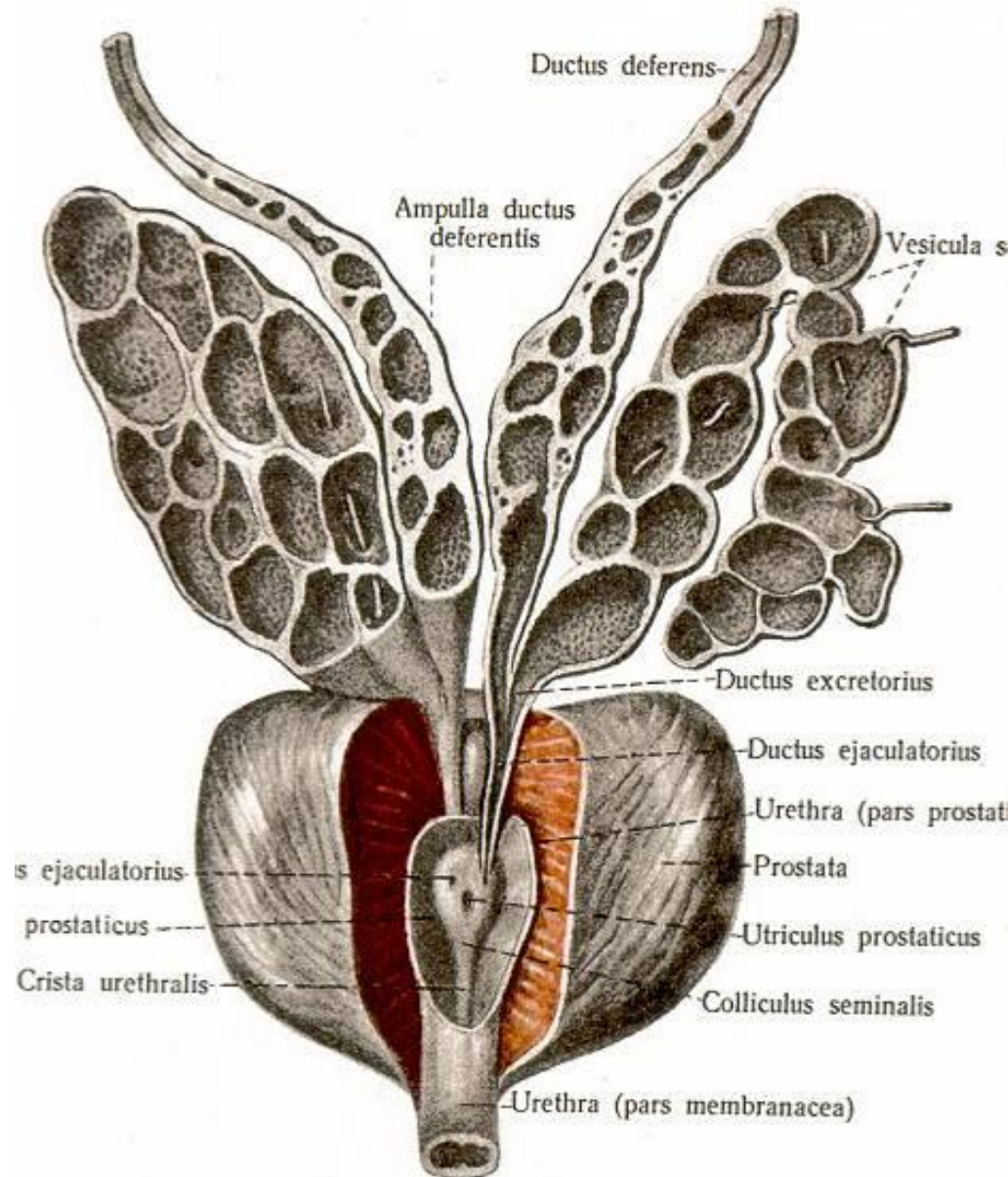


Prostate

internal features

- pars prostatica urethrae
 - crista urethralis
 - colliculus seminalis
 - utriculus prostaticus
 - sinus prostaticus
 - ductuli prostatici (15-30)
- glandulae prostaticae
 - glandulae mucosae
 - glandulae submucosae
 - glandulae principales (30-50)
- area trapezoidea

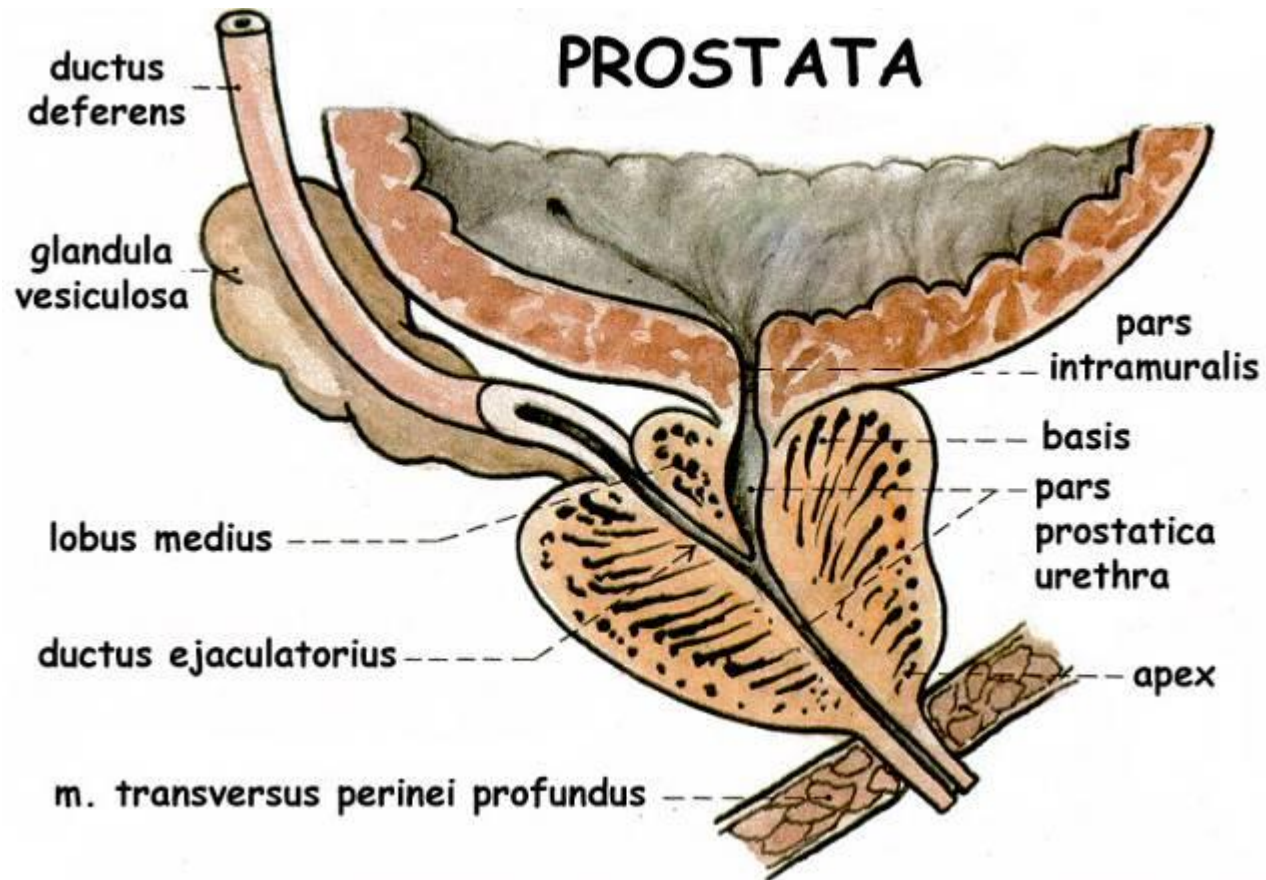
ŘEZ SKRZ PROSTATU a GLANDULAE VESICULOSAE



Prostate – *position and syntopy*

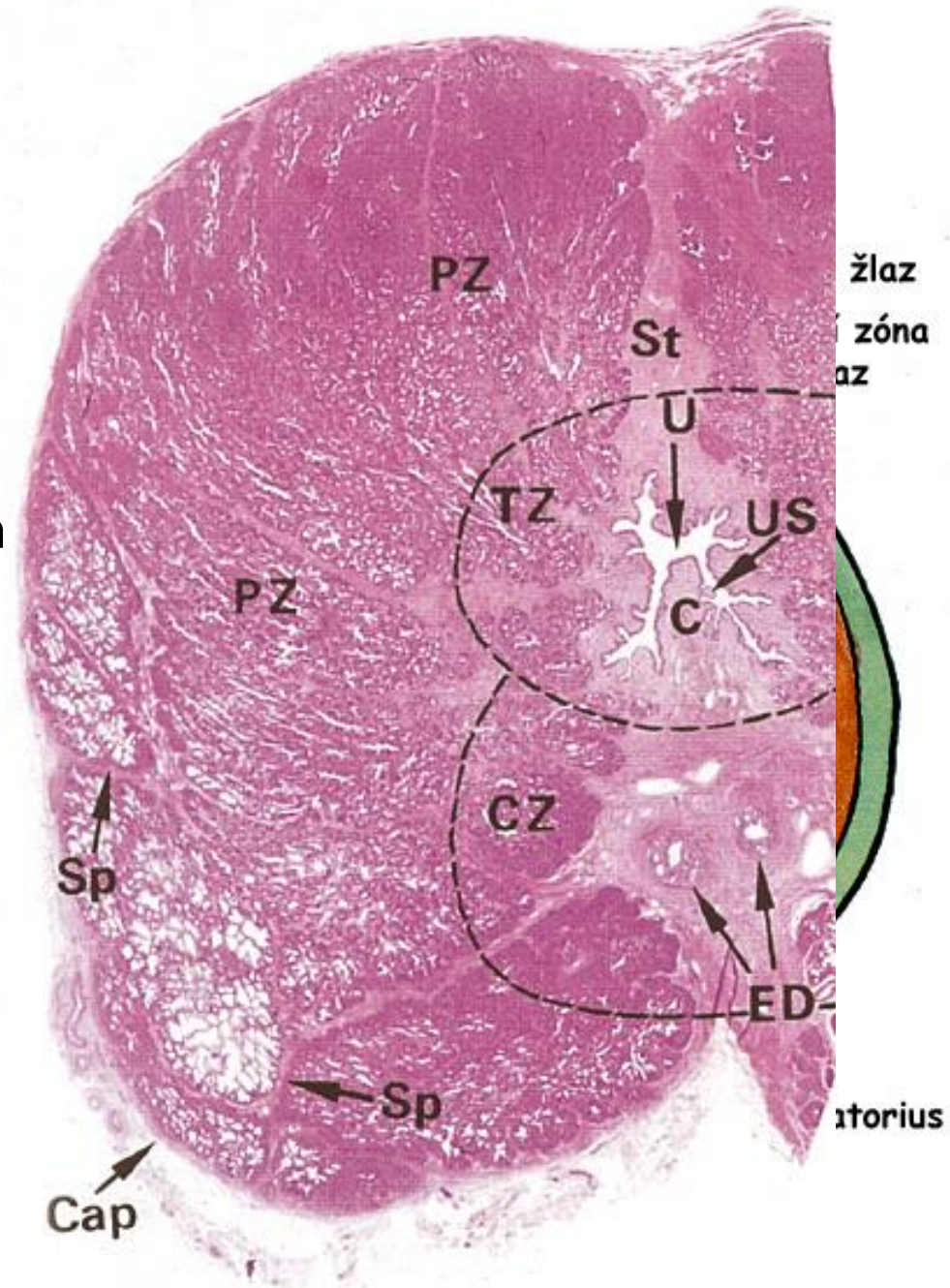
- below urinary bladder subperitoneally
- above diaphragma pelvis

- m. puboprostaticus – striated
- m. vesicoprostaticus – smooth



Prostate section

- capsula periprostatica = fascia pelvis visceralis
- capsula prostatica
 - stratum externum vasculosum = plexus venosus prostaticus
 - stratum intermedium fibrosum
 - stratum internum musculare
- fibromuscular stroma (*stroma fibromyoelasticum*)
- glands (*parenchyma glandulare*): 30-50, tuboalveolar, branched
- urethra (pars prostatica) + ductus ejaculatorii



Histological zones (following McNeal)

- peri-urethral gland zone (*zona glandularium periurethralium*)
 - narrow stripe of mucous glands in the tunica muscularis urethrae
- transition zone (*zona anteromedialis / transitionis*) – 5%
 - upper part between the peripheral and peri-urethral gland zone
- peripheral zone (*zona inferoposterolateralis / peripheralis*) – 70%
 - outer part – principal glands
- central zone (*zona superomedialis / centralis*) – 25 %
 - inner wedge-shaped part around ductus ejaculatorii, submucous glands
- anterior aglandular zone (*isthmus / zona anteromediana*)
 - no glands, only fibromuscular stroma

anterior fibromuscular
stroma

transitional zone

periurethral
zone

prostatic
urethra

Zones after McNeal

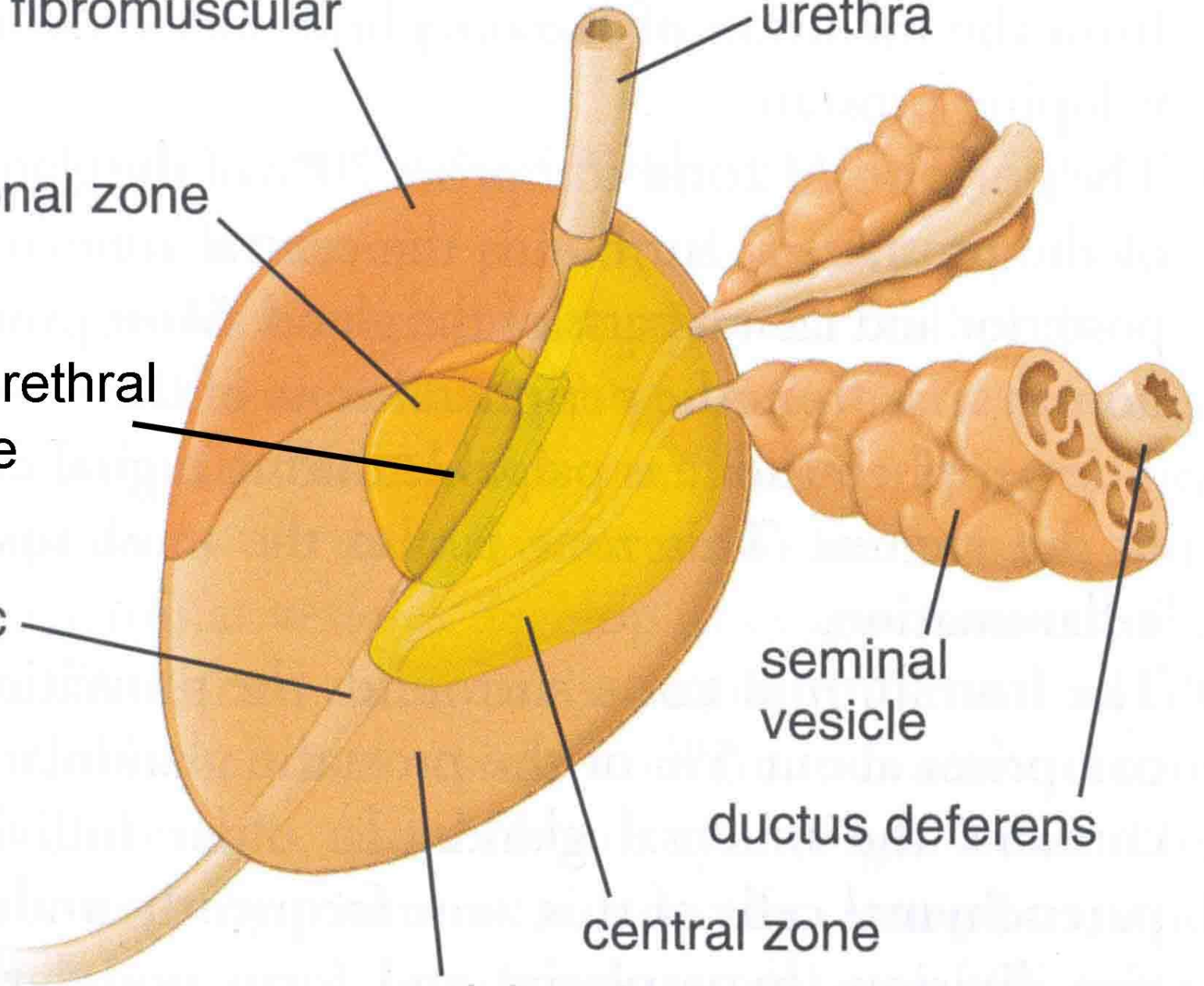
urethra

seminal
vesicle

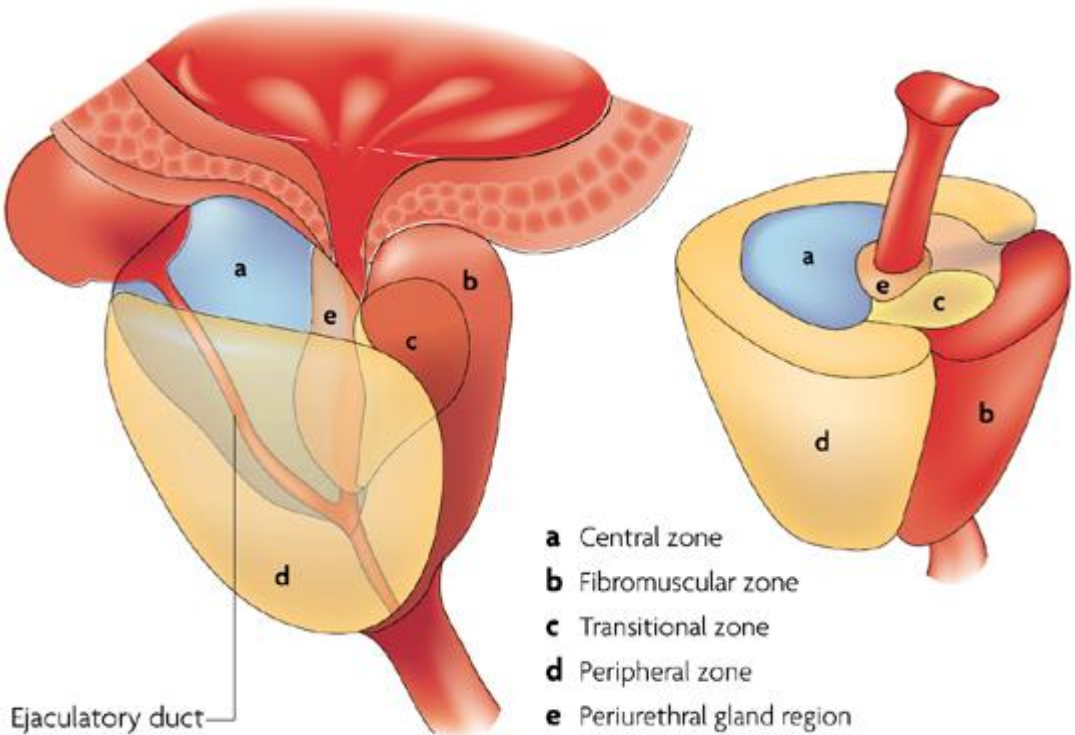
ductus deferens

central zone

peripheral zone

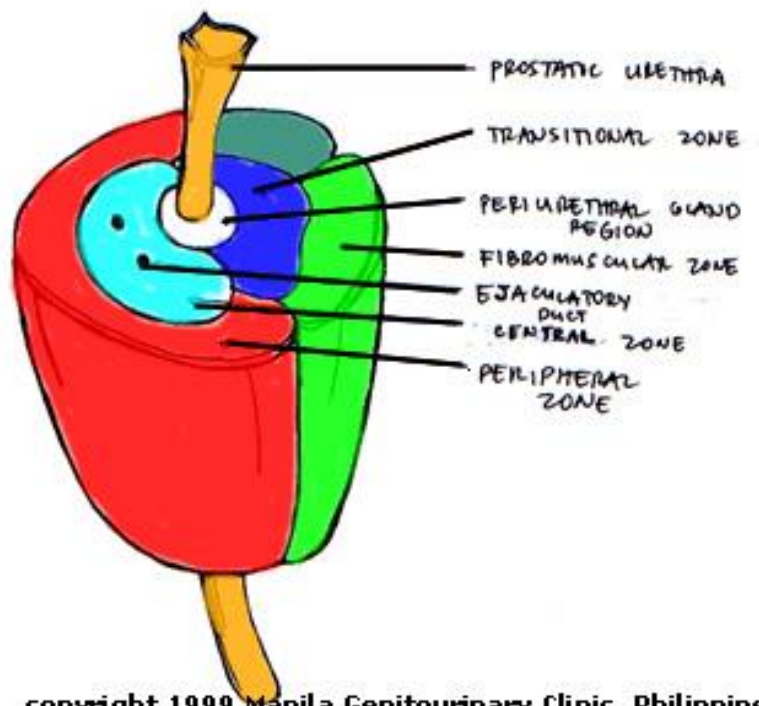


Prostate zones



- a** Central zone
- b** Fibromuscular zone
- c** Transitional zone
- d** Peripheral zone
- e** Periurethral gland region

Ejaculatory duct



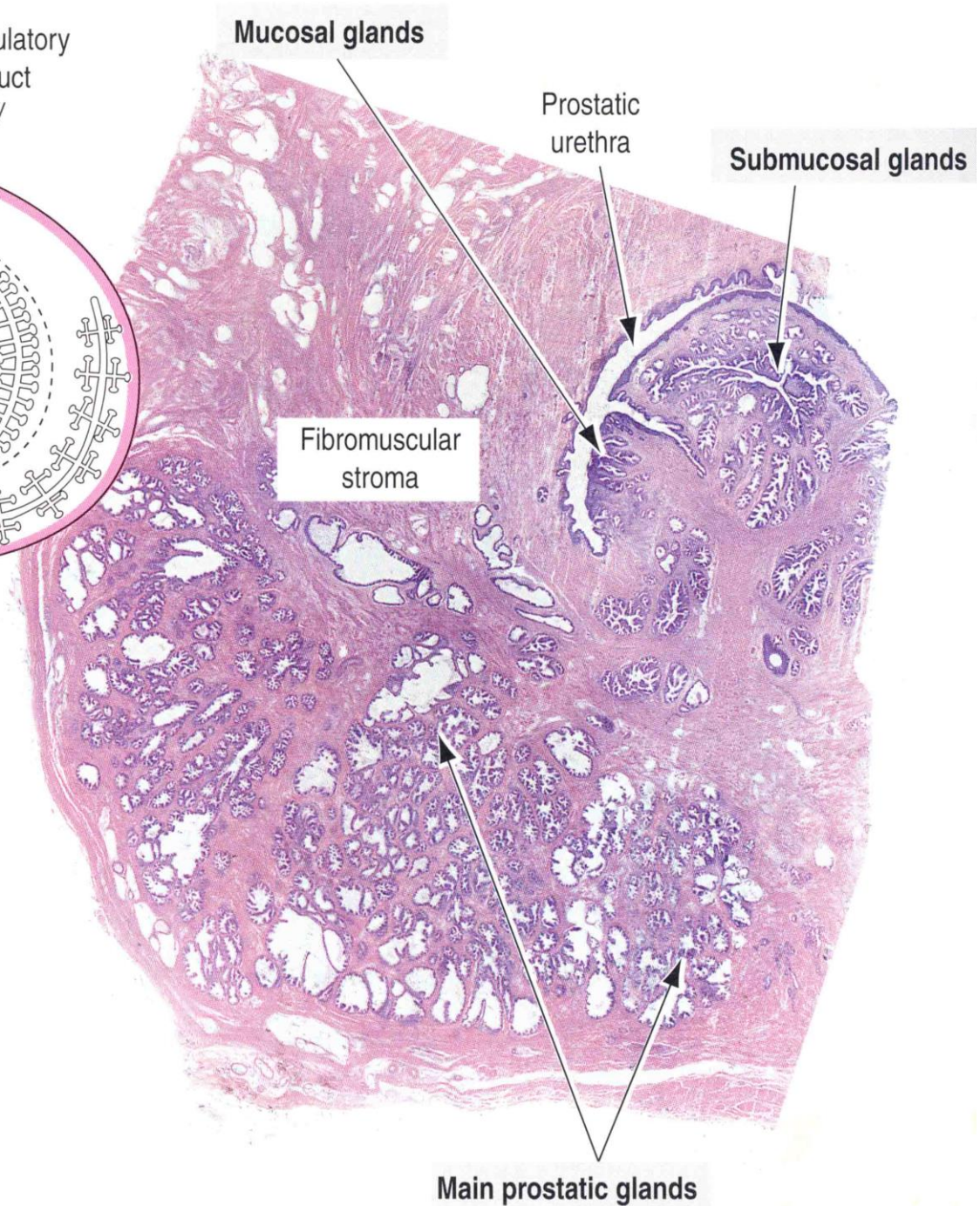
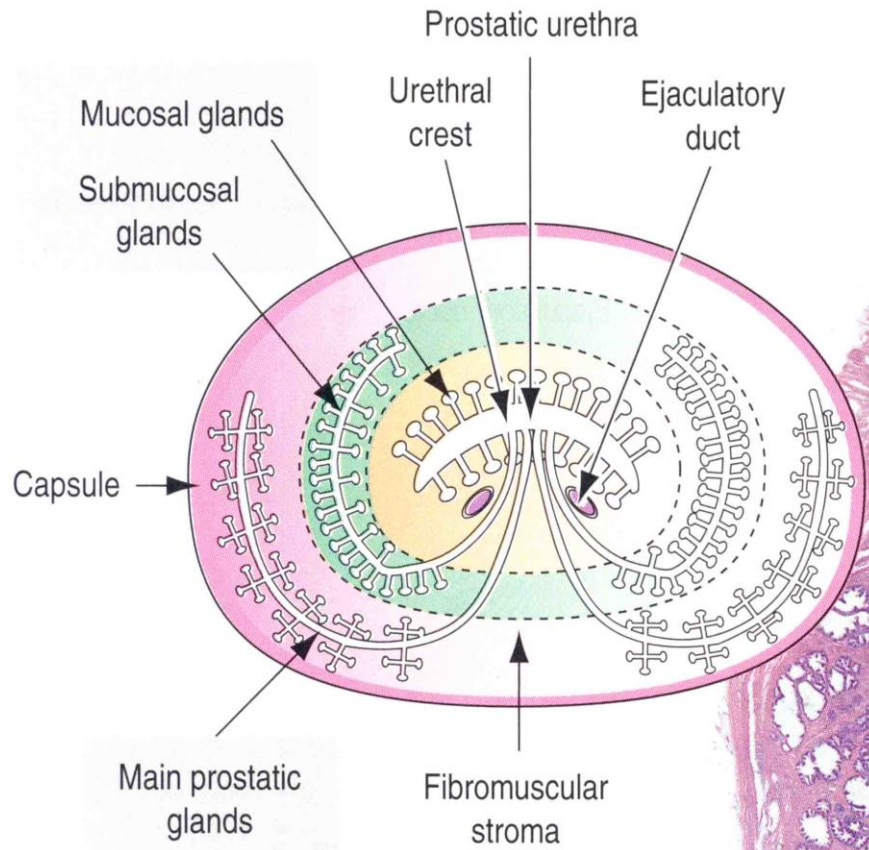
copyright 1999 Manila Genitourinary Clinic, Philippines

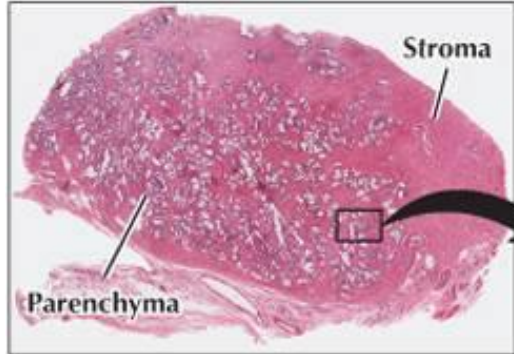
	Prostate zone		
	Peripheral	Transition	Central
Focal atrophy	High prevalence	Medium-high prevalence	Low prevalence
Acute inflammation	Low prevalence	None	Low prevalence
Chronic inflammation	Medium-high prevalence	Medium-high prevalence	Low prevalence
Benign prostatic hyperplasia	Low prevalence	High prevalence	Low prevalence
High-grade PIN	Medium-high prevalence	Low prevalence	Low prevalence
Carcinoma	High prevalence	Medium-high prevalence	Low prevalence

 High prevalence	 Low prevalence
 Medium-high prevalence	 None

Prostate – *internal features*

- **simple flat to columnar** (nuclei in 2 rows) epithelium
 - cell height corresponds to the gland activity
- **principal glands** – acid phosphatase
 - prostasomes (*corpuscula prostatica*) – enzymaticly active substances merging with sperm membrane
- endocrine cells (serotonin, emoláza, chromogranin)
- basal cells and cells producing sialomucin
- **prostatic concretions** (*concretio prostatica; corpus amylaceum*) – 0.2-2 mm; glycoproteins + calcium
- stromal cells
 - 5 α -reductase changes testosterone into dihydrotestosterone (DHT)
- secretion: 30%, pH 7.3
 - zinc, phosphate, calcium, citrate, prostaglandins, spermin and spermidin, proteases
 - **prostatic fraction of acid phosphates (PSAS) and prostatic specific antigen (PSA)**

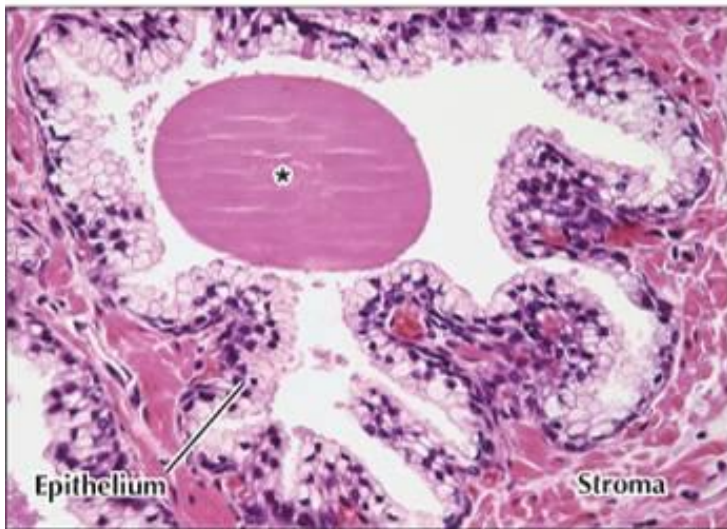




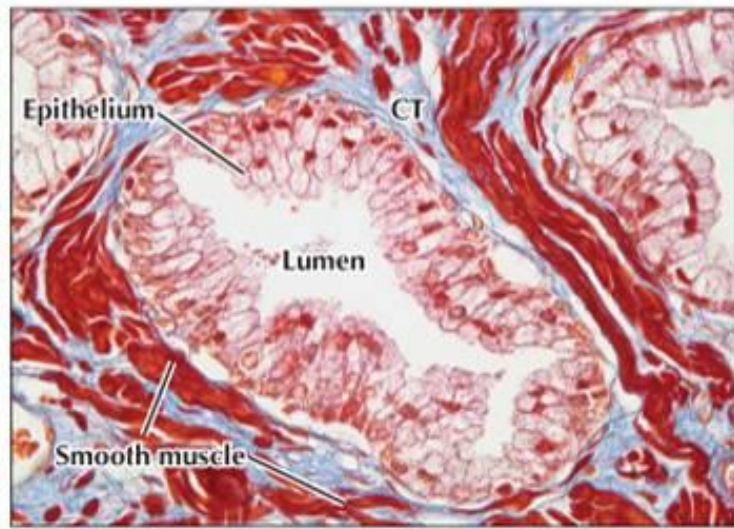
▲ **LM of the prostate at low magnification.** Glandular parenchyma and fibromuscular stroma make up the gland. Note the branching nature of the tubuloalveolar glandular units. 5×, H&E.



► **LM of part of the prostate.** Glandular epithelium lines irregularly shaped secretory alveoli. A prostatic concretion (*) is in an alveolus lumen. Underlying stroma is a mixture of smooth muscle and connective tissue. 115×, H&E.

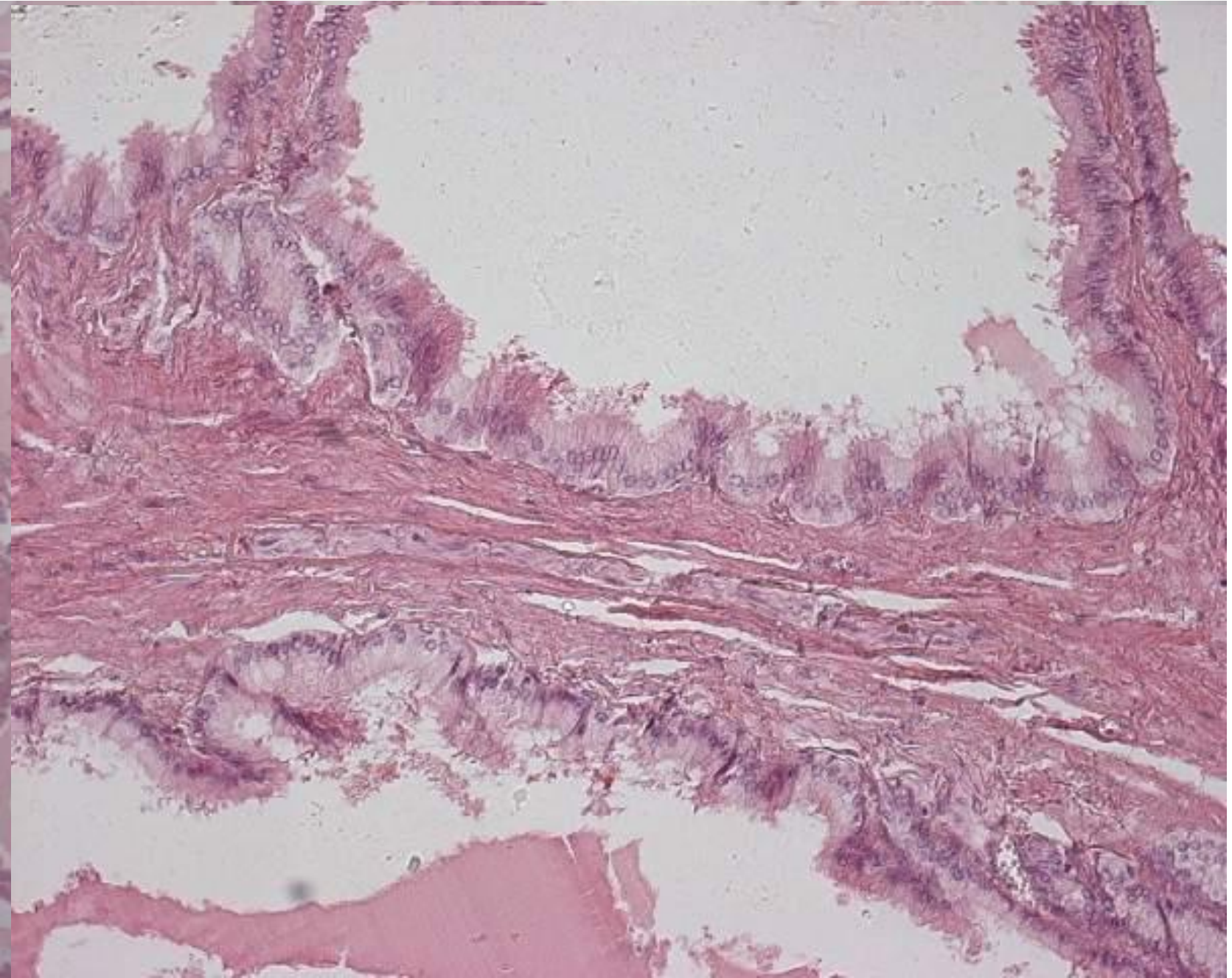


▲ **Higher magnification LM of the prostate.** Pseudostratified epithelium, consisting of columnar cells and small basal cells, lines a secretory alveolus. A prostatic concretion (*) is in the alveolar lumen. A prominent fibromuscular stroma is in adjacent areas. 220×, H&E.



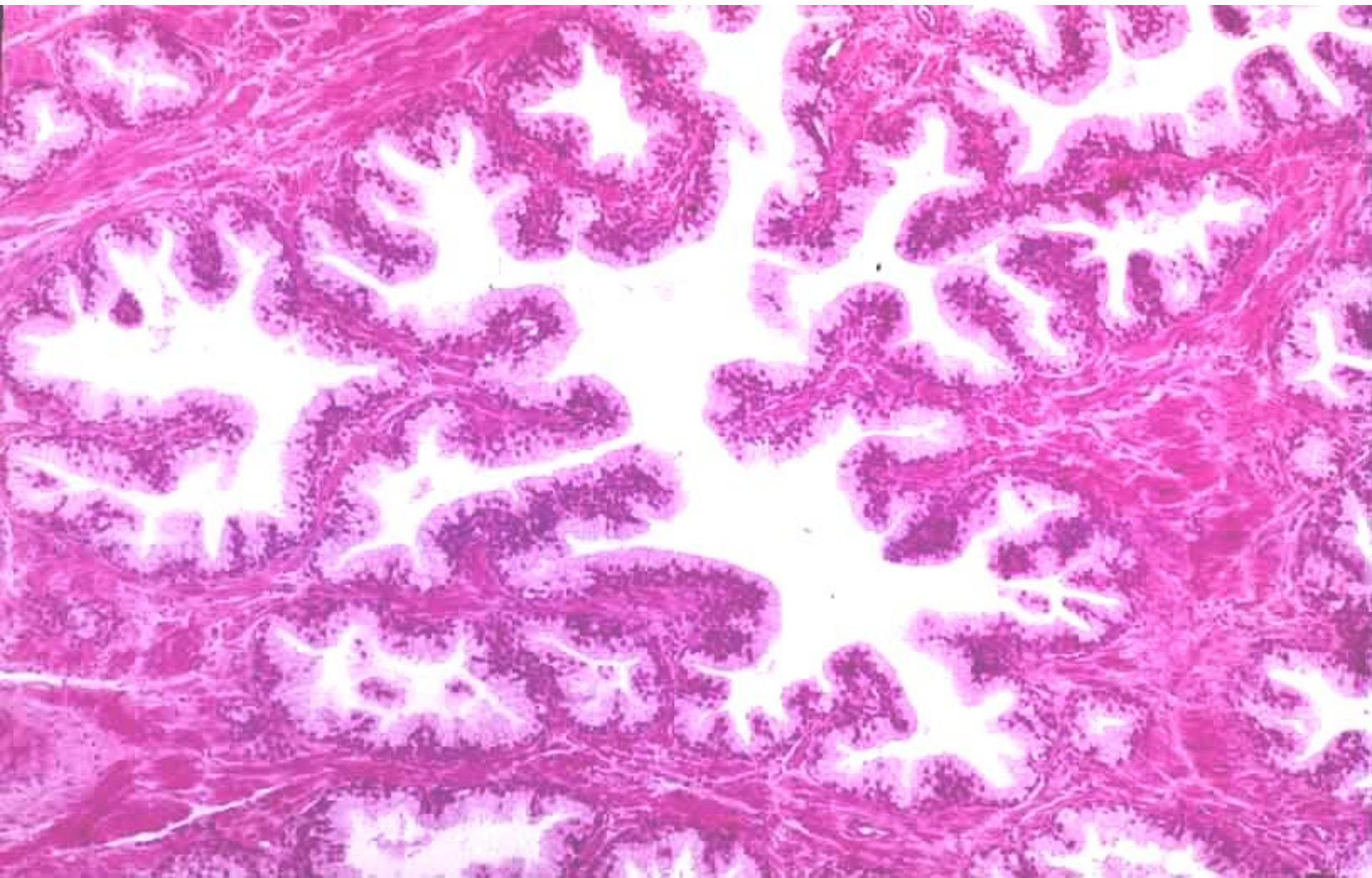
▲ **Higher magnification LM of a secretory alveolus in the prostate.** Columnar epithelial cells, which have lightly stained apical cytoplasm, line the lumen. Smooth muscle cells in the stroma are red; connective tissue (CT) is blue. 300×, Masson's trichrome.

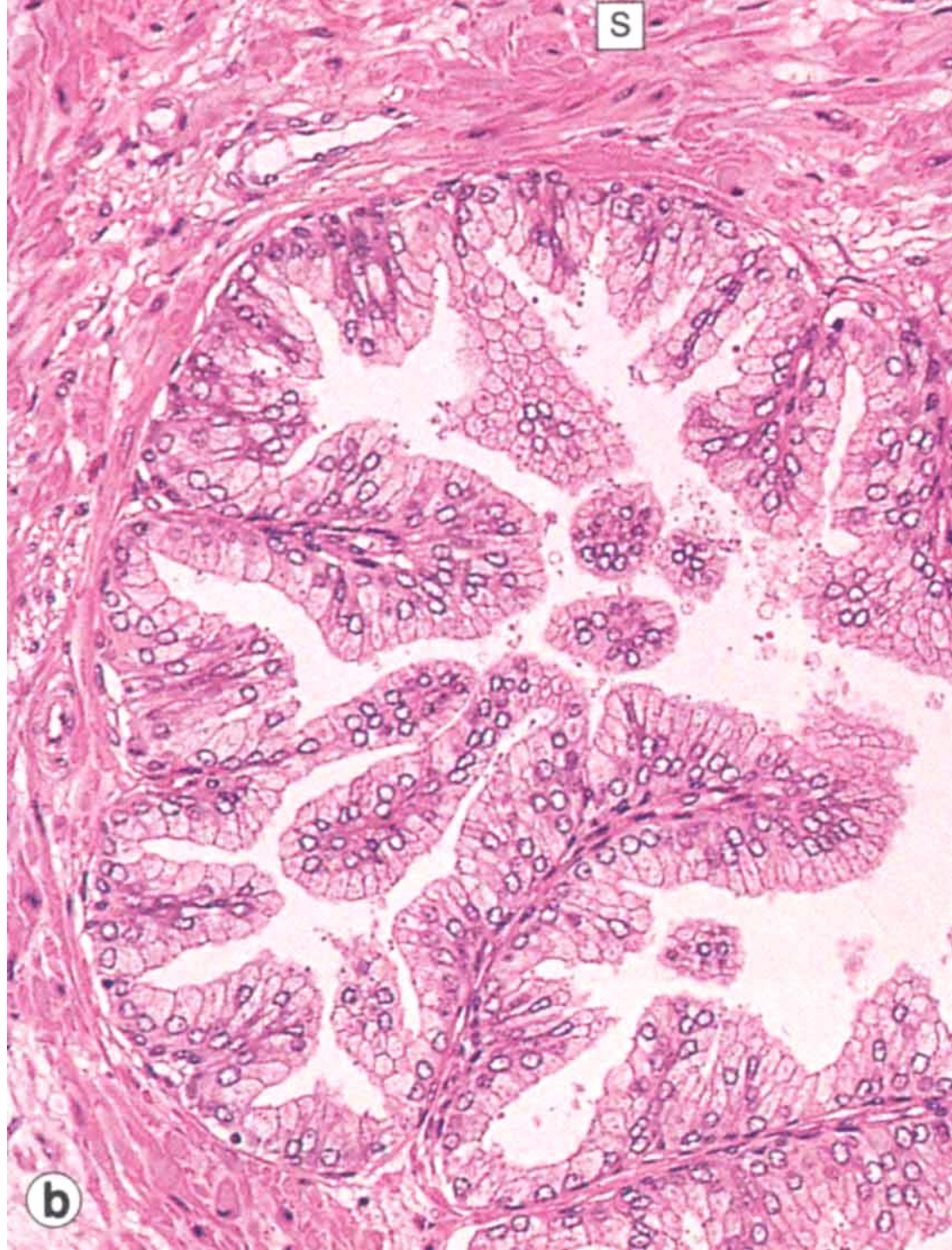
Prostata HE



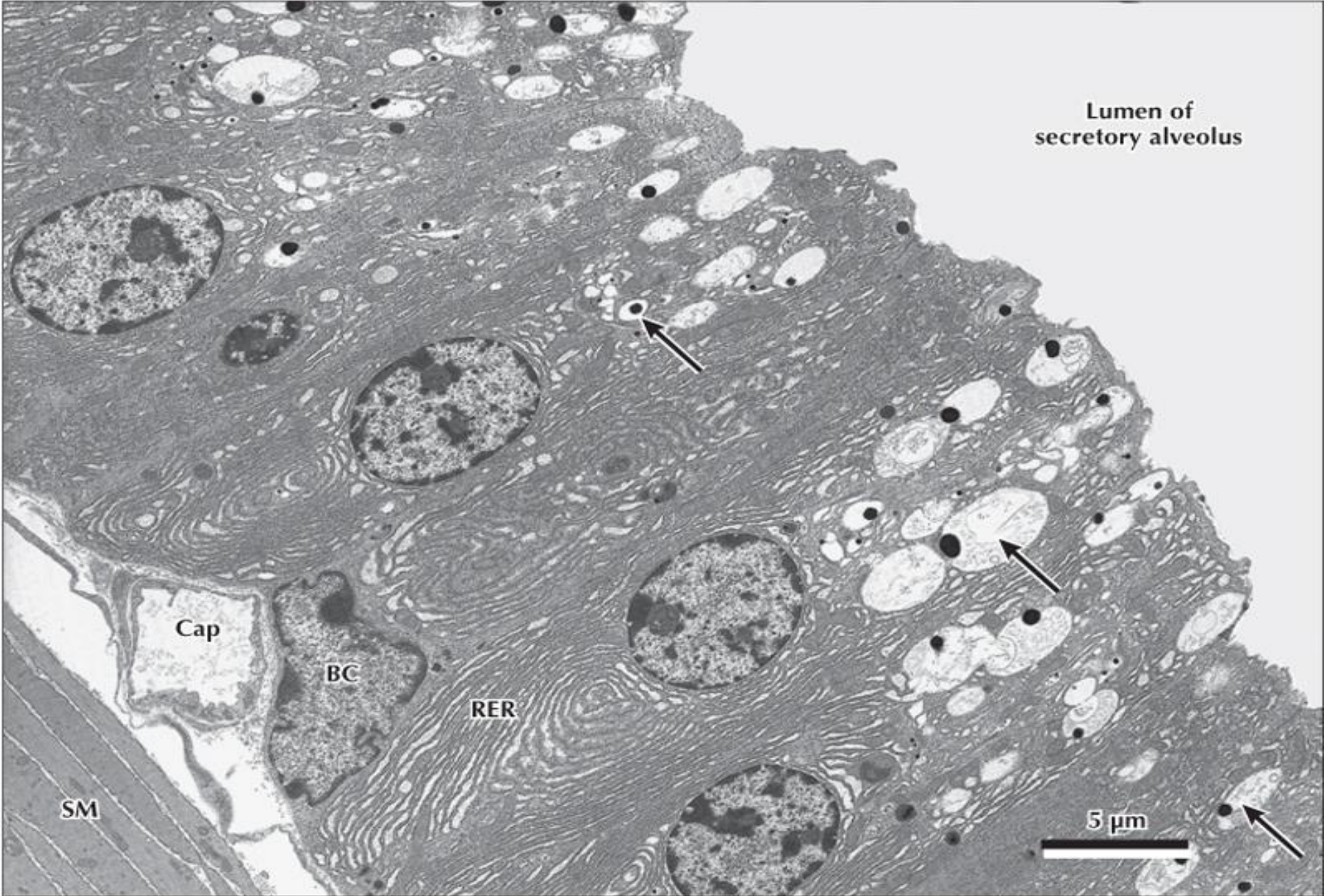
Prostata WvG



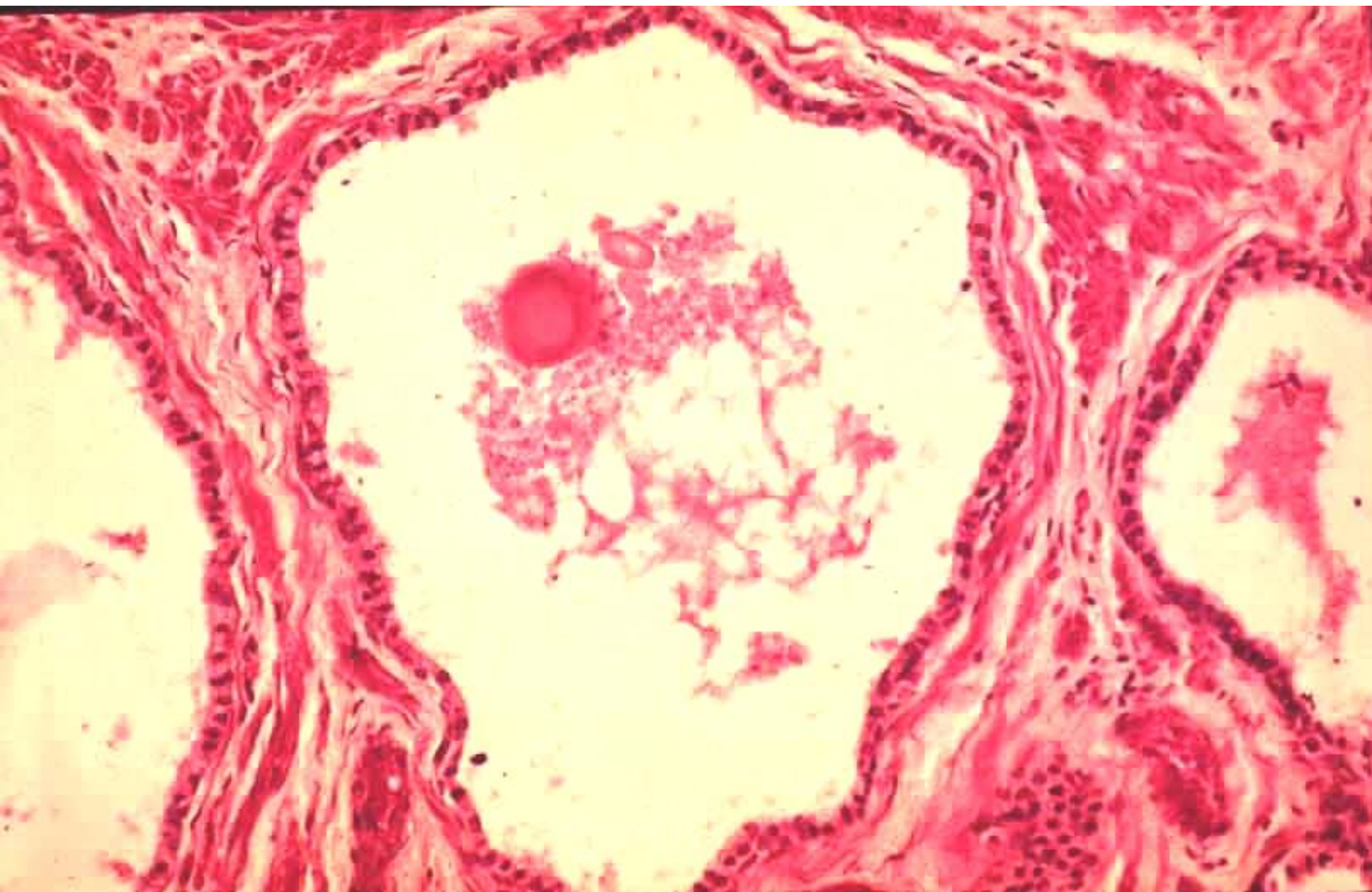


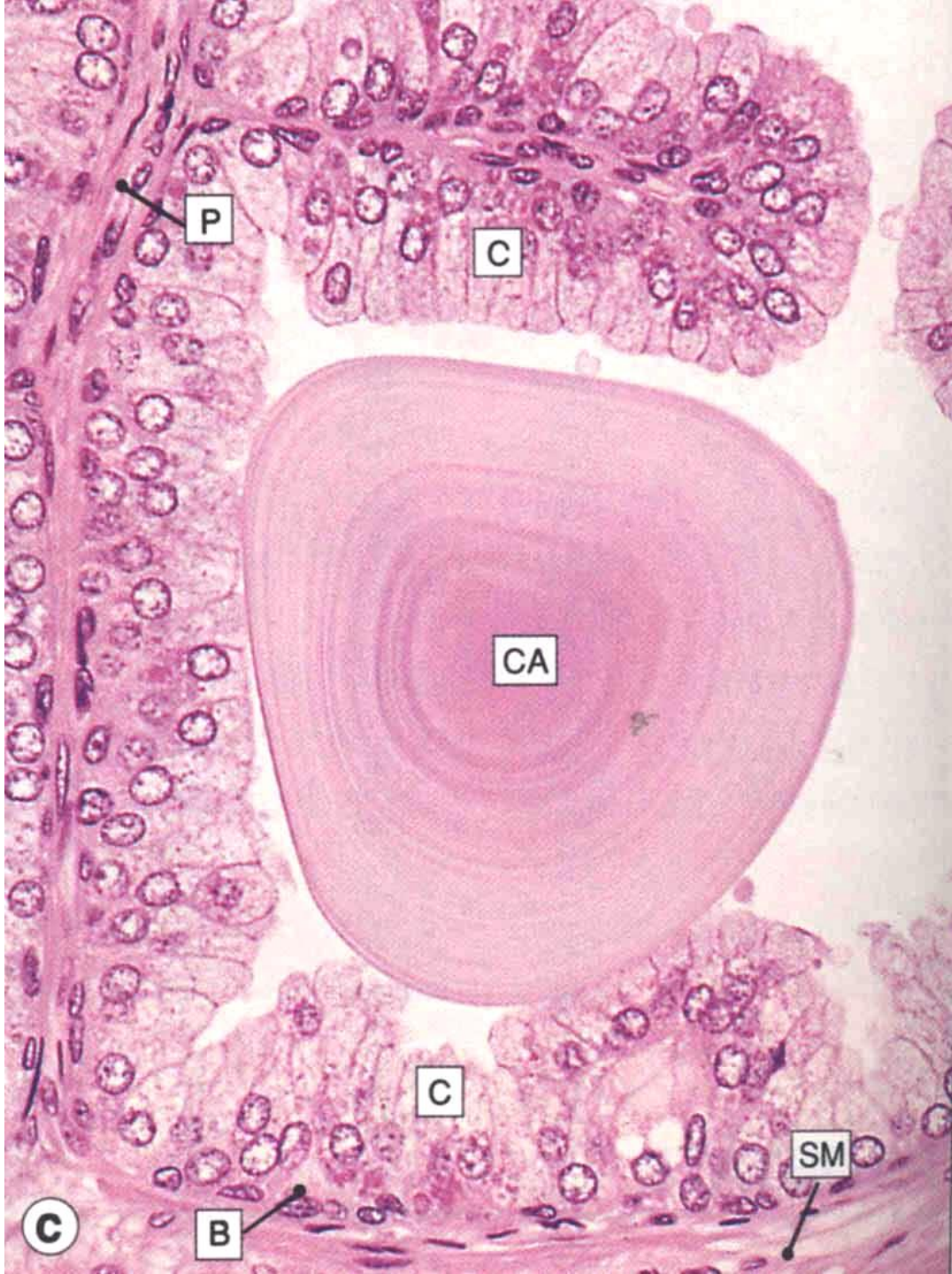


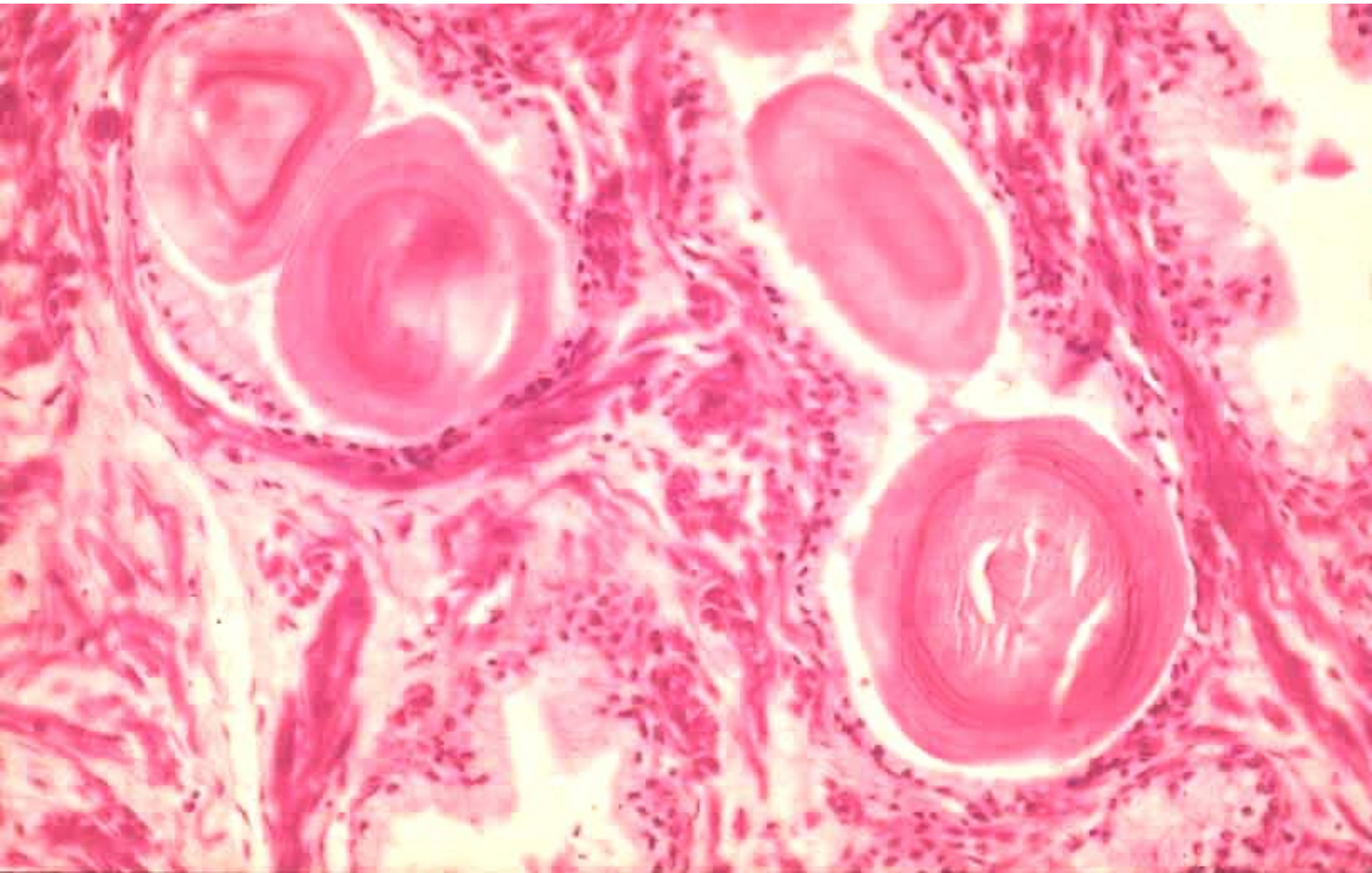




▲ **Survey EM of mouse prostatic epithelium.** The secretory nature of the columnar epithelial cells is clear, even if individual cell borders are difficult to distinguish. Multiple **RER** cisternae occupy basal cytoplasm; large secretory vesicles (**arrows**) are supranuclear. Small basal cells (**BC**) are next to the basement membrane. Underlying lamina propria contains a fenestrated capillary (**Cap**) and smooth muscle cells (**SM**). 4000 \times .

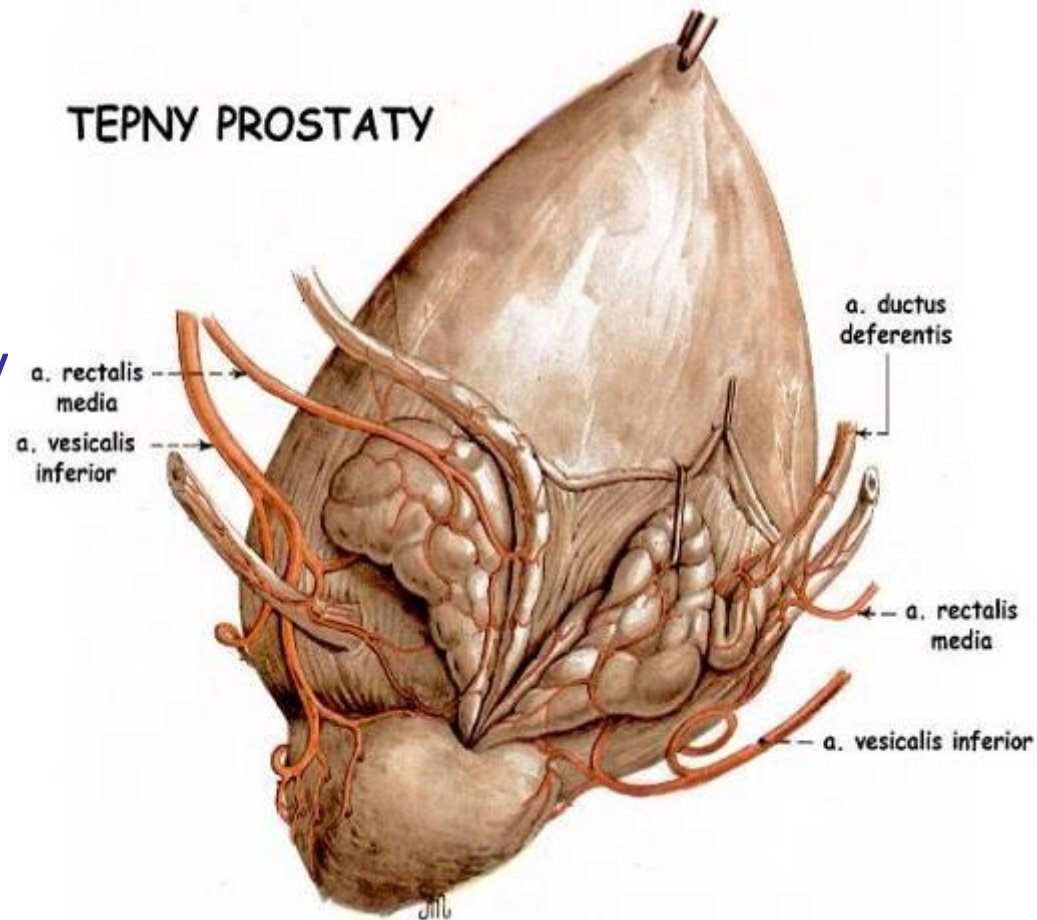






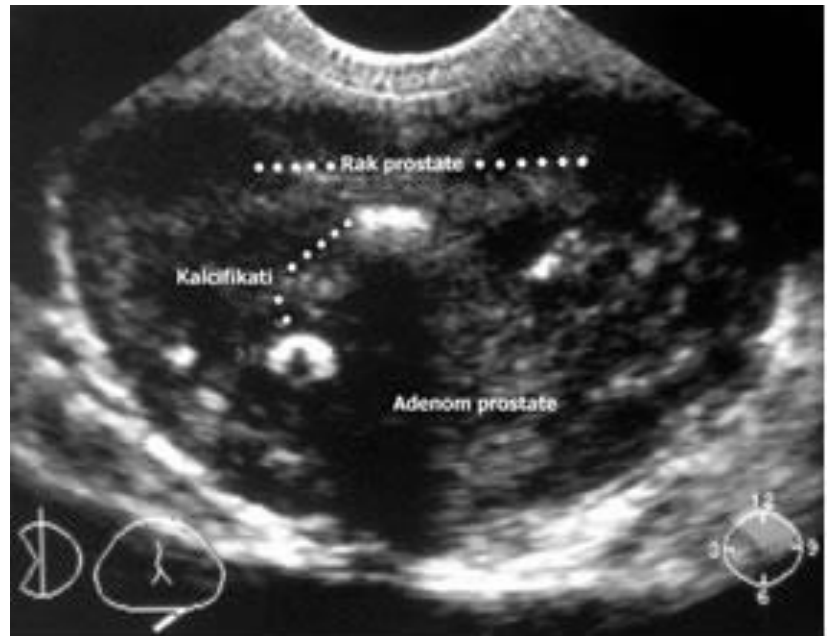
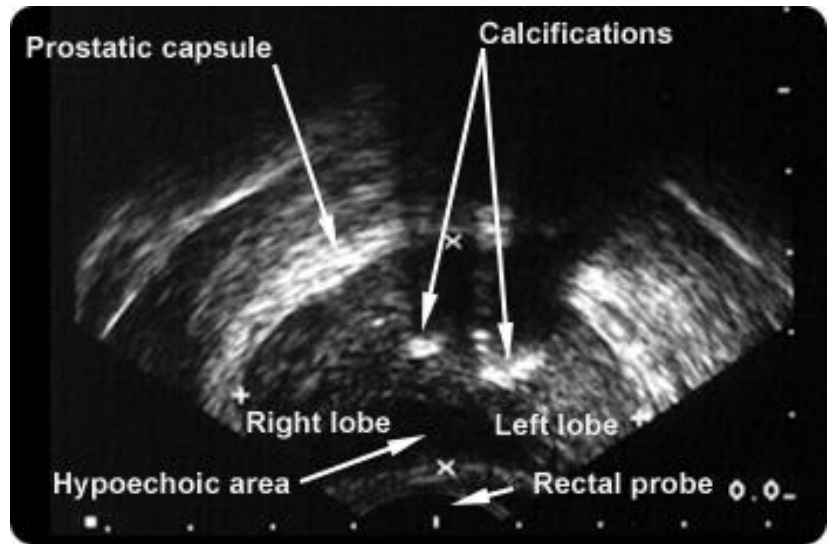
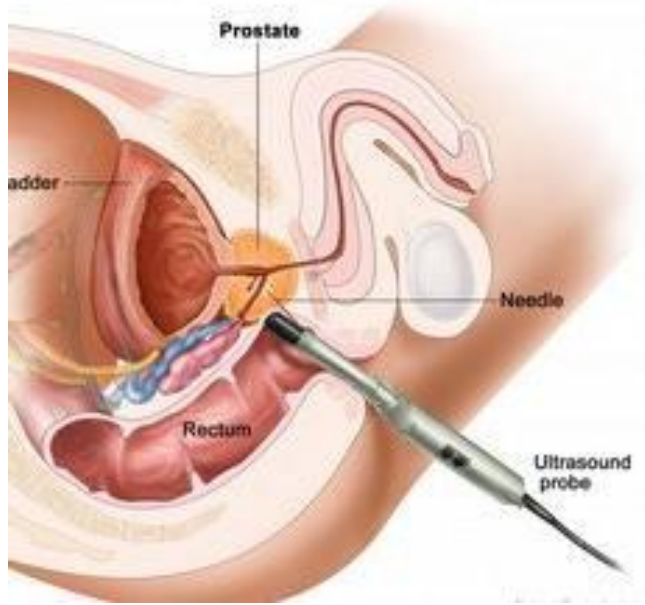
Prostata + glandulae vesiculosae *supply*

- Arteries: branches from **a. iliaca int.** →
a. ductus deferentis
a. vesicalis inferior
a. rectalis media
- Veins: plexus venosus prostaticus + vesicalis → **v. iliaca int.**
- Lymph: **n. l. iliaci int.** + ext.
n.l. sacrales (prostate only!)
- Nerves: plexus hypogastricus inf. → plexus prostaticus



Prostate – *clinical relevance*

- benign hyperplasia
 - 50% over age 50
 - hyperplasia of submucous glands in the transition and central zone
 - ↑ level of DHT (5-alpha-reductase)
 - peripheral zone changes into thin and rigid surgical capsule
- malign carcinoma
 - 85% originates in the peripheral zone
 - ↑ level of prostatic fraction of acid phosphatase (PSAP) and PSA in blood



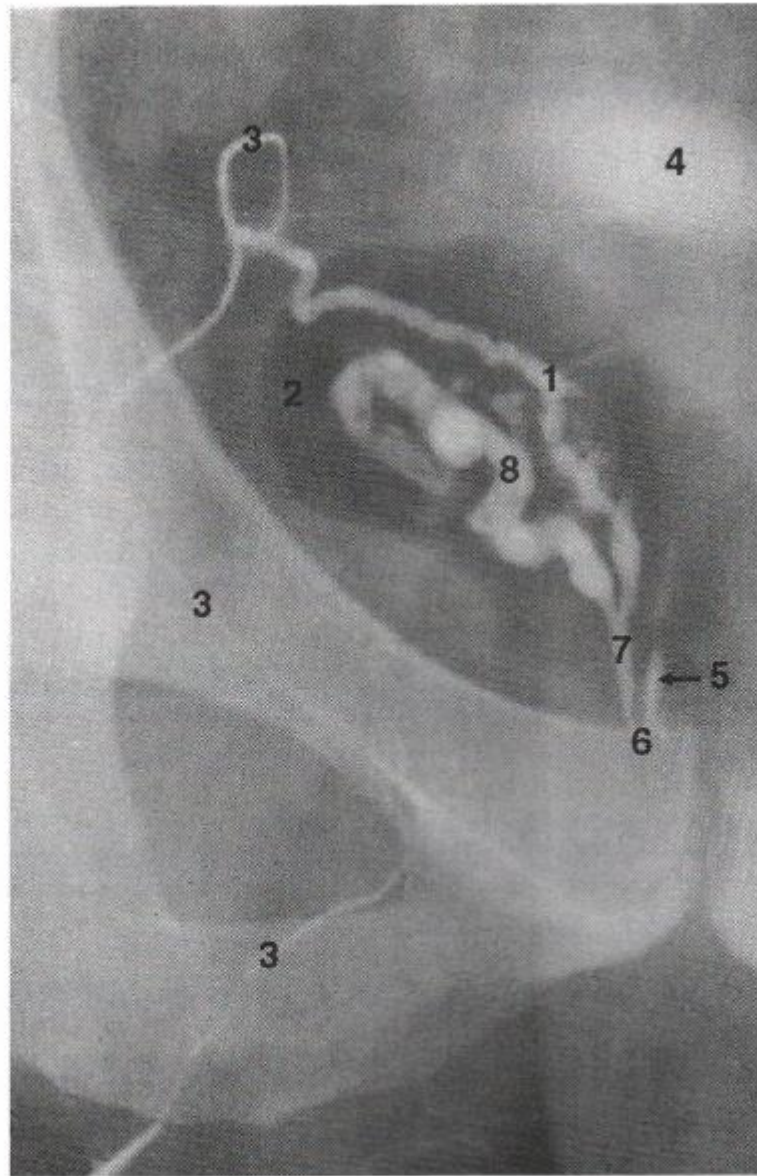


Figure 4-13. A seminal vesiculogram. (1) Ampulla of ductus deferens; (2) colonic gas; (3) ductus deferens (vas deferens); (4) full urinary bladder; (5) left ejaculatory duct; (6) position of seminal colliculus (verumontanum); (7) right ejaculatory duct; (8) seminal vesicle. Reproduced with permission from Weir, J and Abrahams, PH: *Imaging Atlas of Human Anatomy*, 2e, London, UK, Mosby International, 1997.

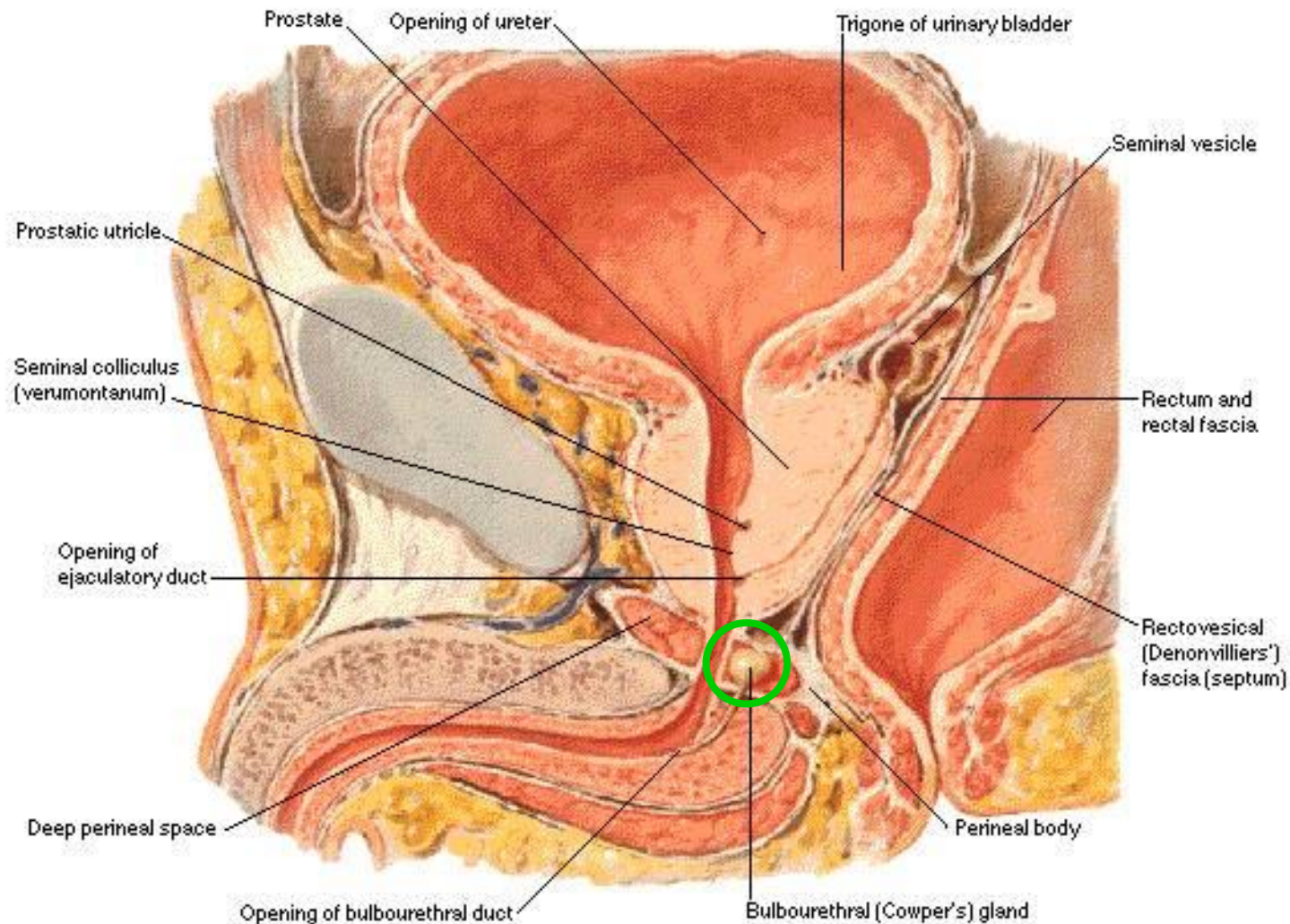
Bulbo-urethral gland

Glandulae bulbourethrales Cowperi

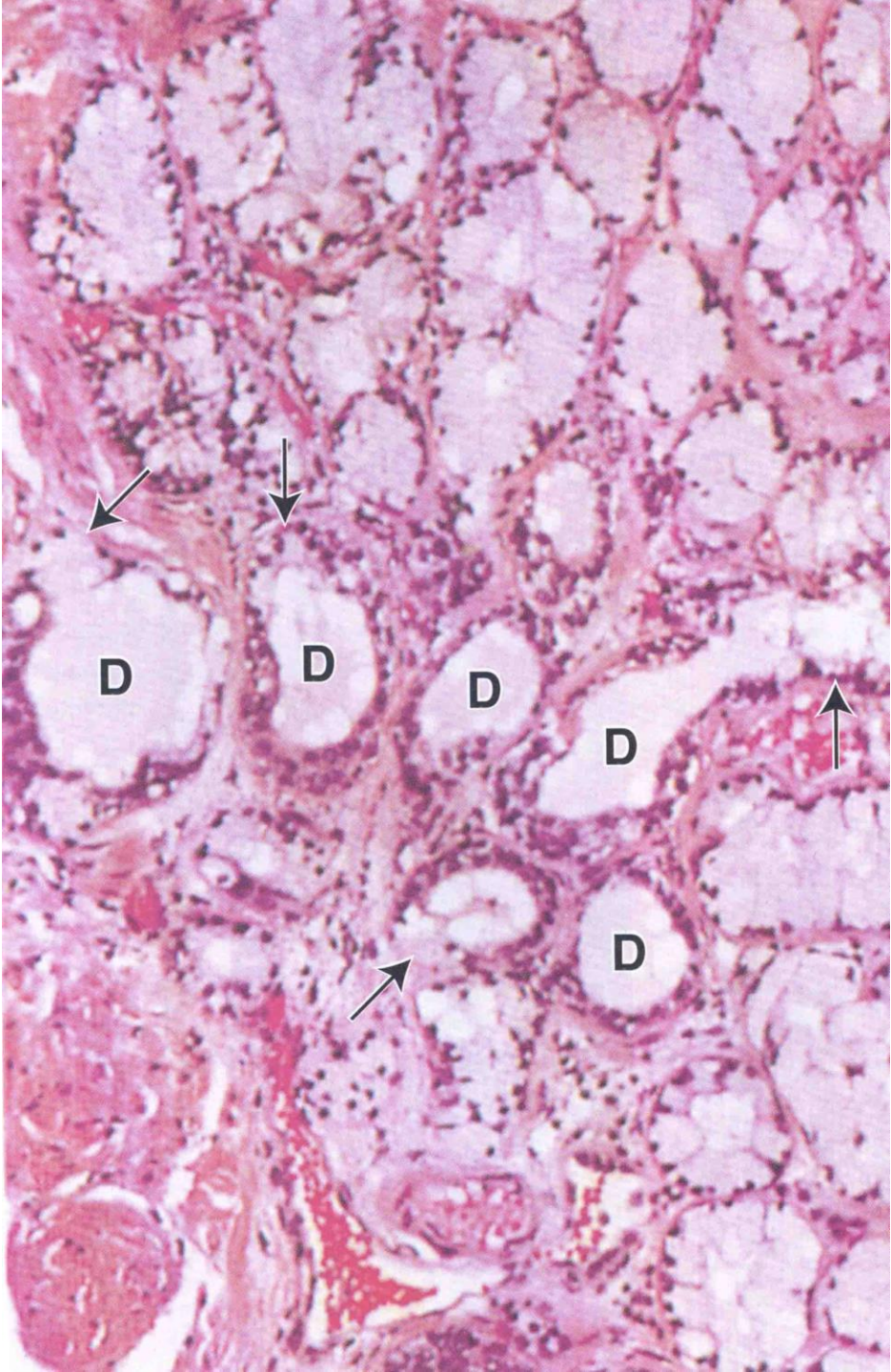
- paired
- compound mucinous tuboalveolar glands
 - simple columnar epithelium
 - secretory and endocrine cells
- pea-sized (5-10 mm)
- within m. transversus perinei profundus from below
- short duct (*ductus gl. bulbourethralis*) – 3 mm
 - stratified columnar epithelium
 - basal, columnar and goblet cells
- opens into *ampulla urethrae* (enlarged beginning of pars spongiosa urethrae)
- Secretion (preejaculate; preseminal Cowper's fluid):
transparent, sticky, lubricates urethra for ejaculate to pass (galactose, sialic acid)

Bulbo-urethral gland

Glandulae bulbourethrales Cowperi



Glandulae
bulbourethrales
Cowperi



Male urethra = *Urethra masculina*

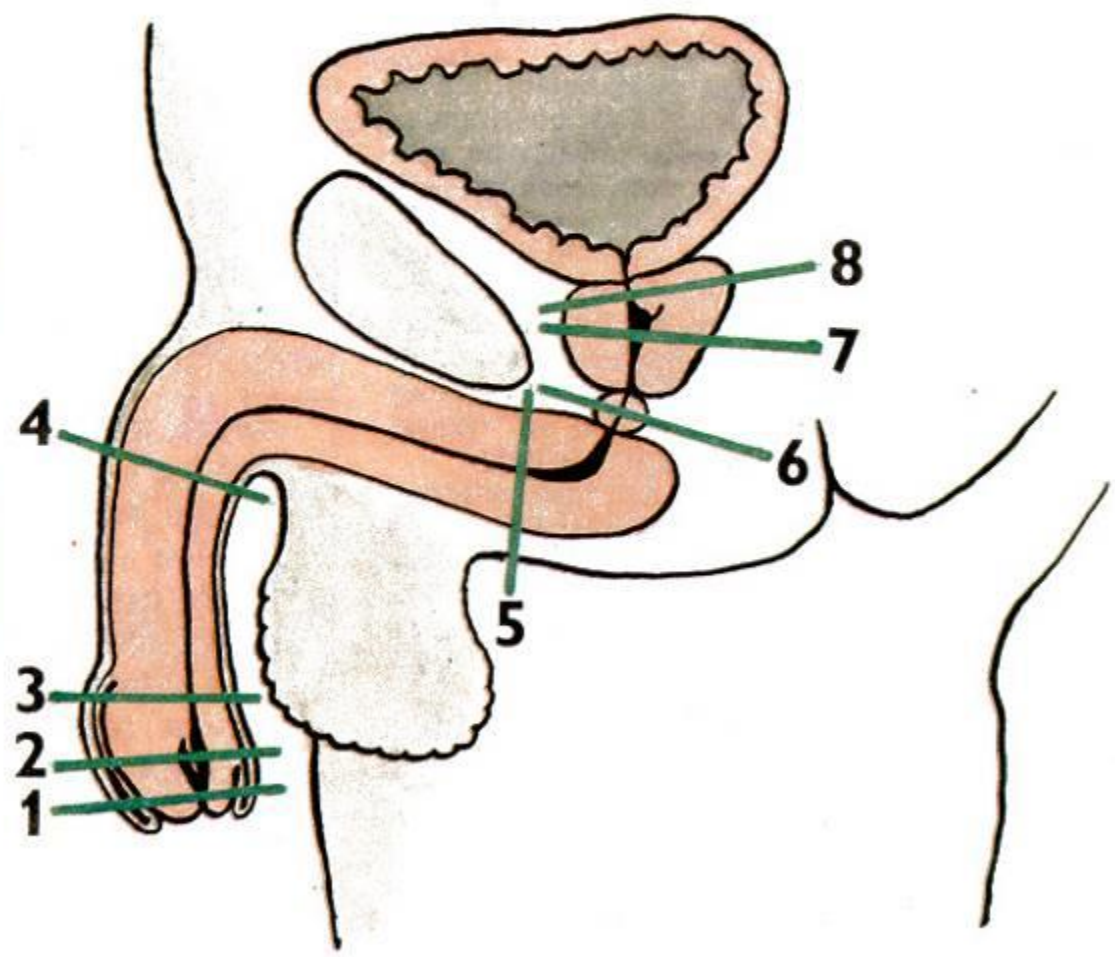
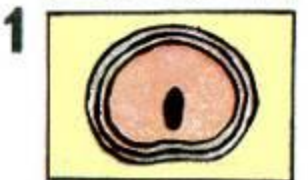
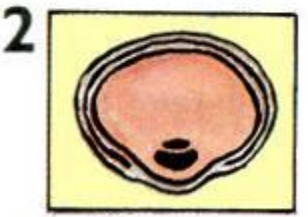
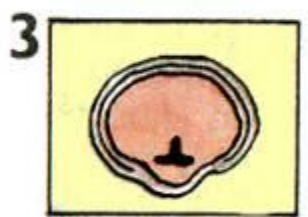
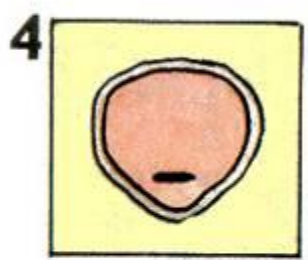
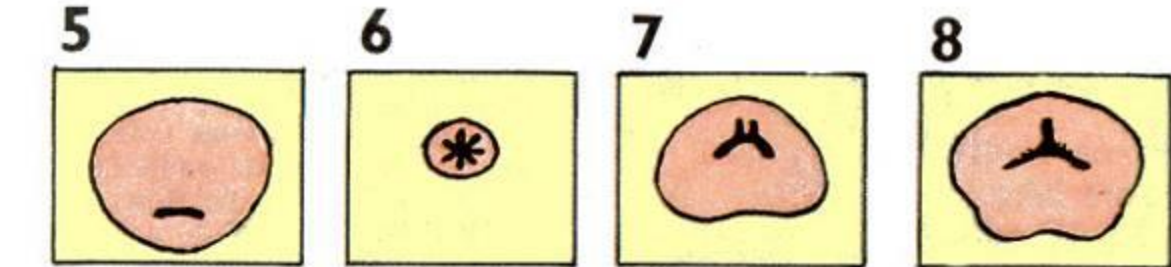
- ostium urethrae internum (accipiens, evacuans)
- pars intramuralis
- **pars prostatica** (pars proximalis x distalis)
 - crista urethralis, colliculus seminalis, utriculus prostaticus
- **pars intermedia** (= membranacea)
 - m. sphincter urethrae externus
- **pars spongiosa** (**ampulla, fossa navicularis**)
 - lacunae et glandulae urethrales, glandulae et ductus paraurethrales
- ostium urethrae externum
- constrictions (4) and **enlargements (3)**
- *clinical division*: anterior and posterior urethra

Male urethra = *Urethra masculina*

- first 2 parts: transition epithelium (urothelium)
- next 2 parts: stratified columnar epithelium
- in fossa navicularis: stratified squamous epithelium
- in ostium urethrae externum: keratinizing stratified squamous epithelium

the whole pars spongiosa urethrae possesses:

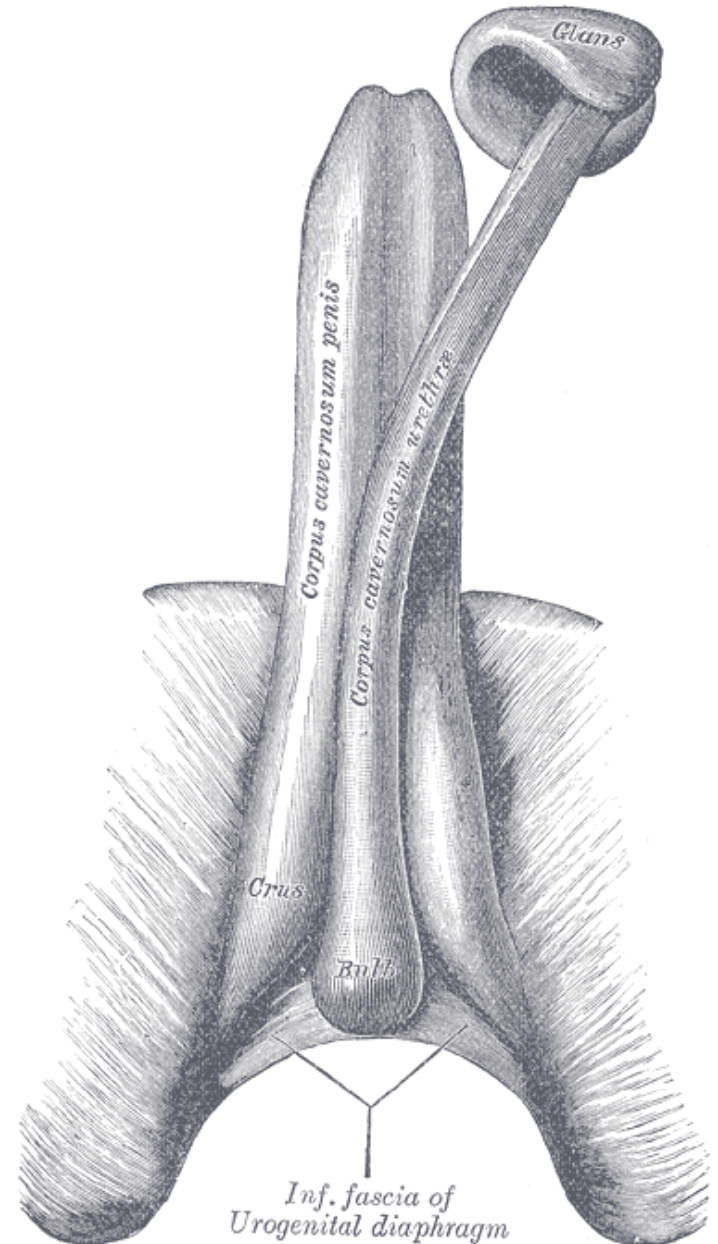
- lacunae urethrales (*Morgagni*)
 - intraepithelial mucous glands
 - in whole pars spongiosa urethrae
- glandulae urethrales (*Littréi*)
 - small mucous, tuboacinous
 - Lubrication
- inconstant folds („valves“) – block catheterisation
 - valvula fossa navicularis



URETHRA MASCULINA

Penis

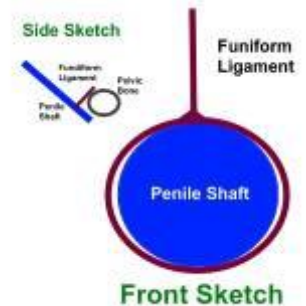
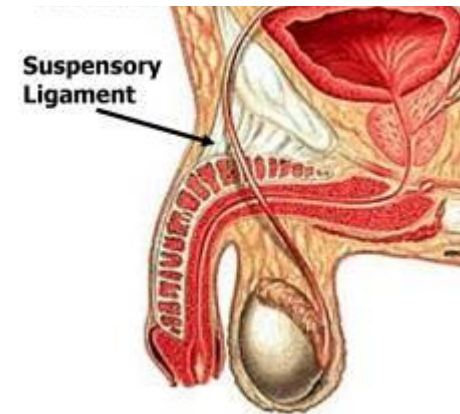
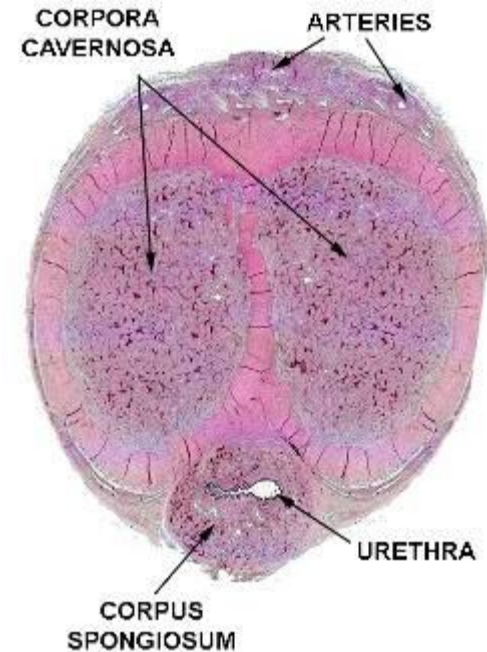
- radix
- crus dextrum + sinistrum
- corpus
- dorsum + facies urethralis
- glans
 - corona, collum
- preputium
 - frenulum
 - (glandulae preputiales *Tysoni*)
- raphe
- corpora cavernosa (2)
- corpus spongiosum (1)
 - bulbus



Penis

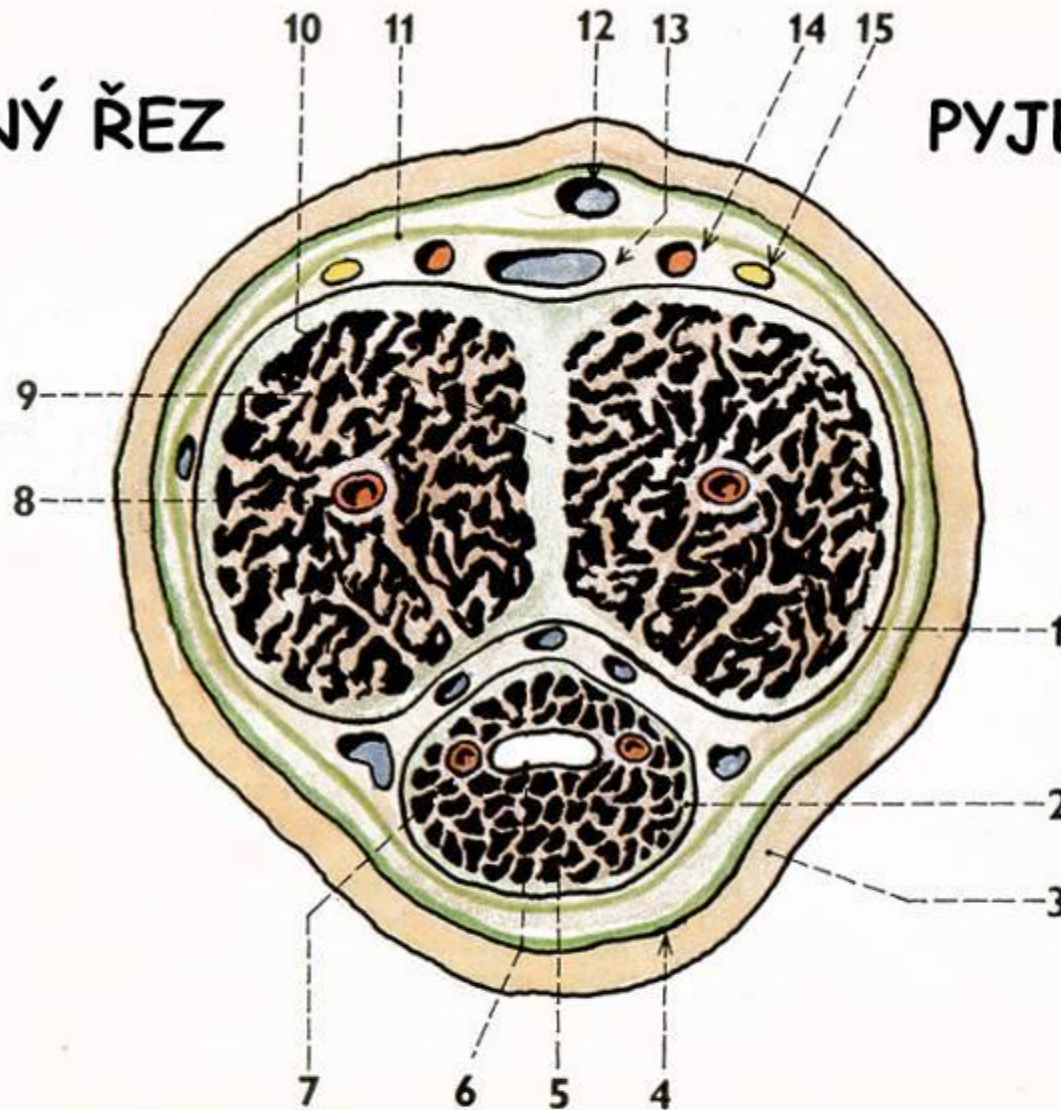
internal features

- tunica albuginea
- septum
- trabeculae
- cavernae
- covers:
 - fascia penis superficialis
 - fascia penis profunda (Bucki)
- fixation:
 - ligamentum fundiforme
 - ligamentum suspensorium
 - crura penis to crista phallica ossis pubis



PŘÍČNÝ ŘEZ

PYJEM



1 / tunica albuginea

2 / jemnější tunica albuginea na corpus spongiosum

3 / kůže

4 / fascia penis superficialis

5 / corpus spongiosum penis

6 / urethra (její pars spongiosa)

7 / a. urethralis

8 / a. profunda penis

9 / corpus cavernosum penis

10 / septum penis (septum pectiniforme)

11 / fascia penis profunda

12 / v. dorsalis penis superficialis (někdy nepárová)

13 / v. dorsalis penis profunda (nepárová)

14 / a. dorsalis penis

15 / n. dorsalis penis

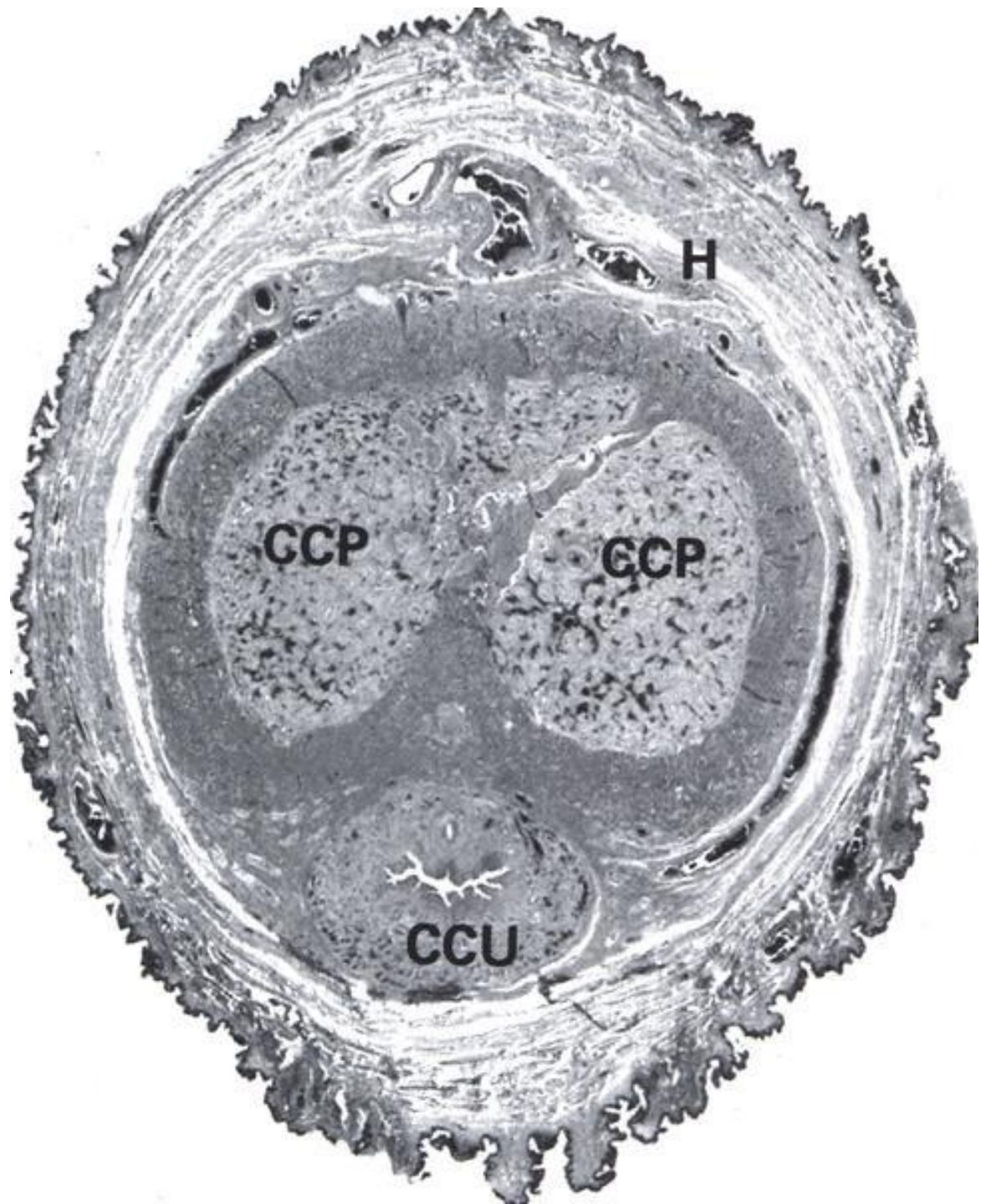
Penis – vascular supply

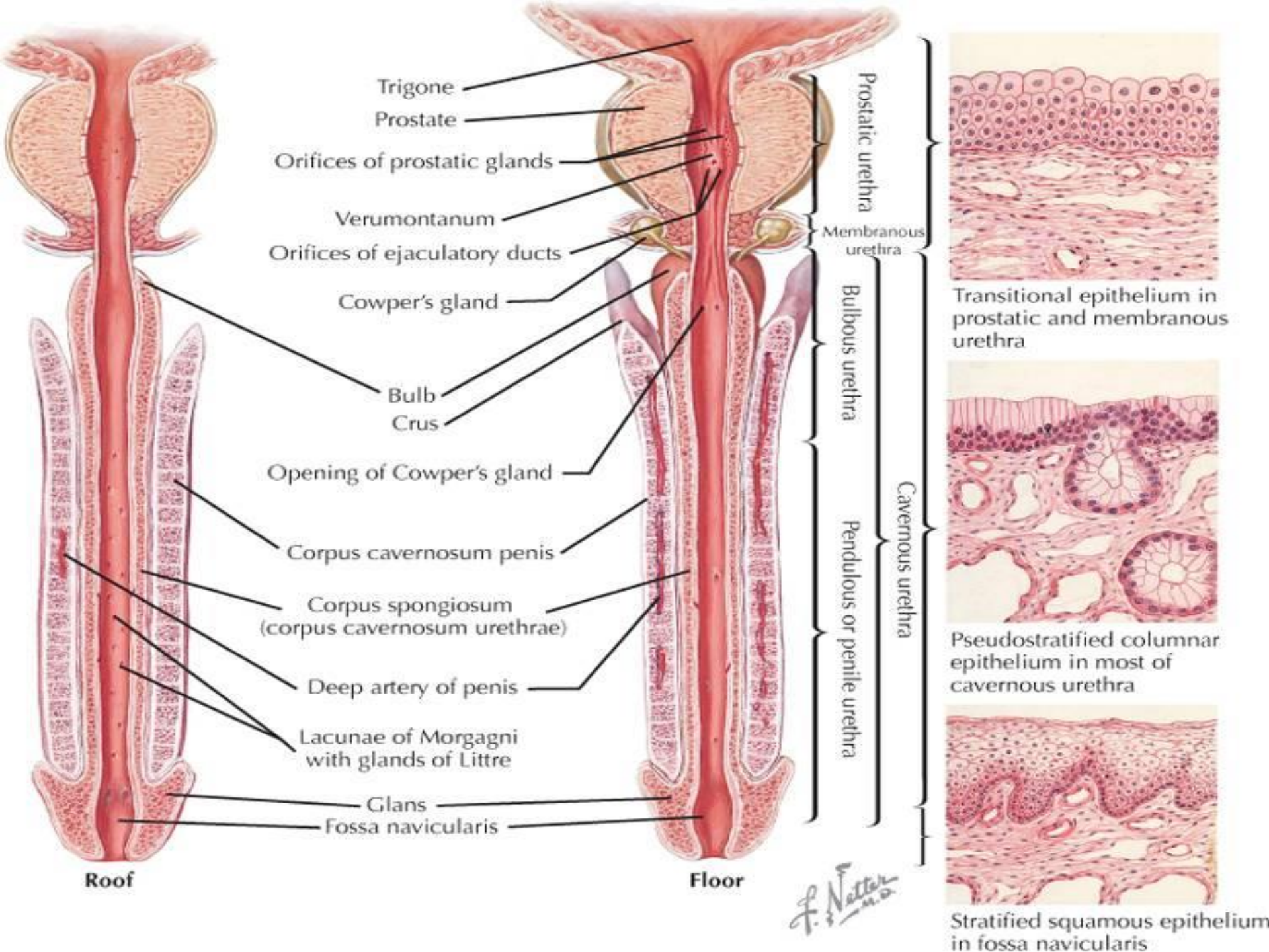
- Arteries:
 - branches from **a. pudenda interna** (a. dorsalis et profunda penis, a. urethralis, a. bulbi penis) → aa. helicinae (+ von *Ebner's cushions*) → vv. cavernosae
- Veins: vv. cavernosae
 - v. dorsalis penis spf. → **vv. pudendae externae** → v. femoralis
 - v. dorsalis penis prof. bifurcates into the plexus pudendus *Santorini* + v. pudenda interna
 - v. bulbi penis + v. urethralis → **v. pudenda interna** → v. iliaca int.

Penis

lymph drainage and innervation

- Lymph:
 - **n.l. inguinales superficiales** – Cabanas' node (skin)
 - **n.l., profundi** (glans penis)
 - **n.l. iliaci interni** (erectile bodies, urethra)
- Nerves:
 - n. pudendus
 - *sympathetic fibers* from plexus hypogastricus inf.
 - *parasympathetic fibers* from nn. splanchnici sacrales S2-4 (Onuf's nucleus)
 - glans penis is the most richly innervated skin area of body!!!

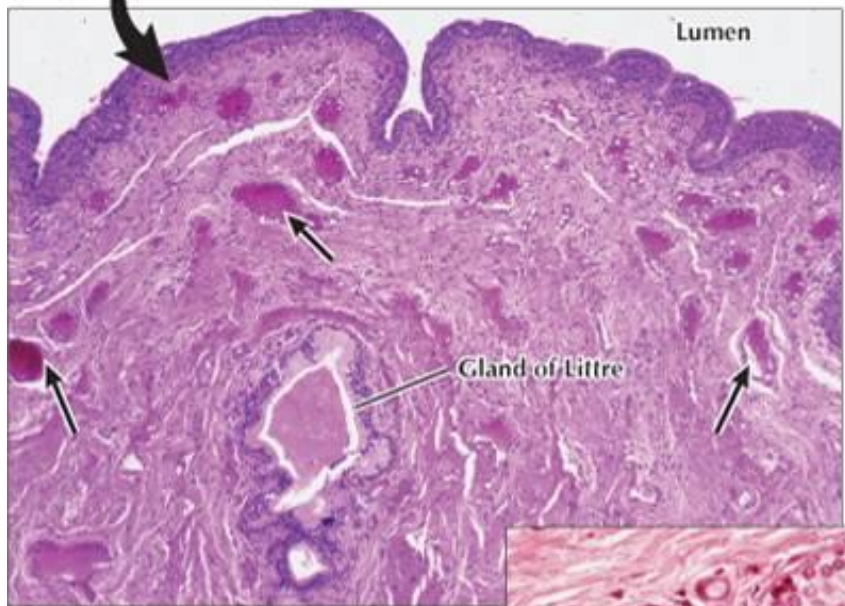
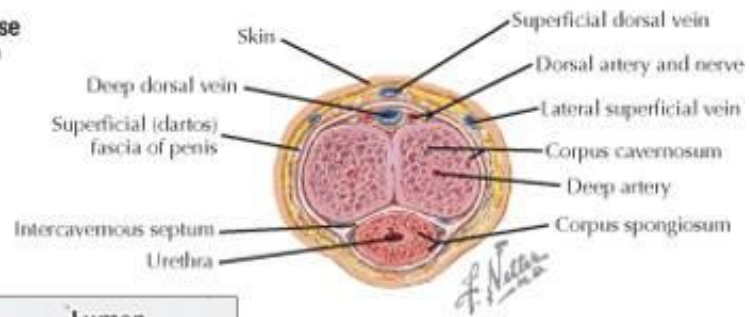




Section through the shaft of the penis.

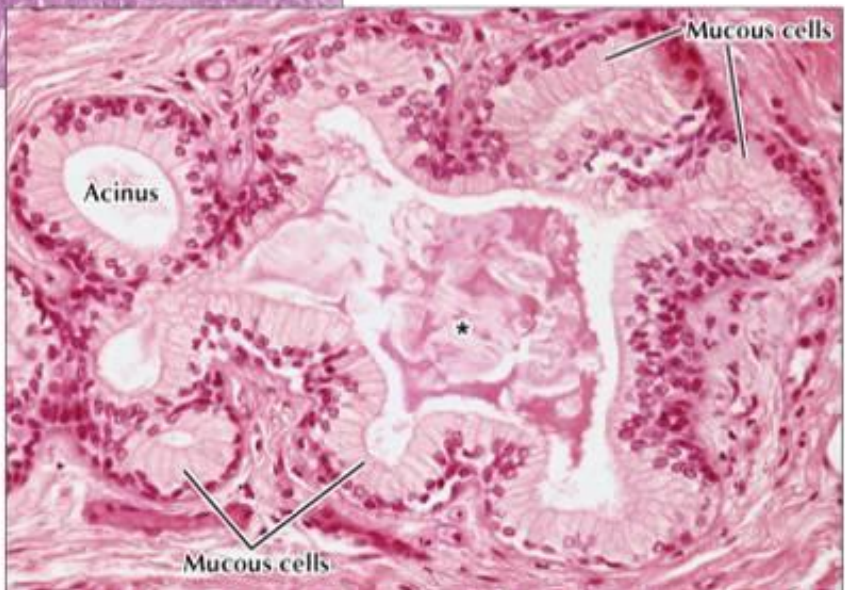


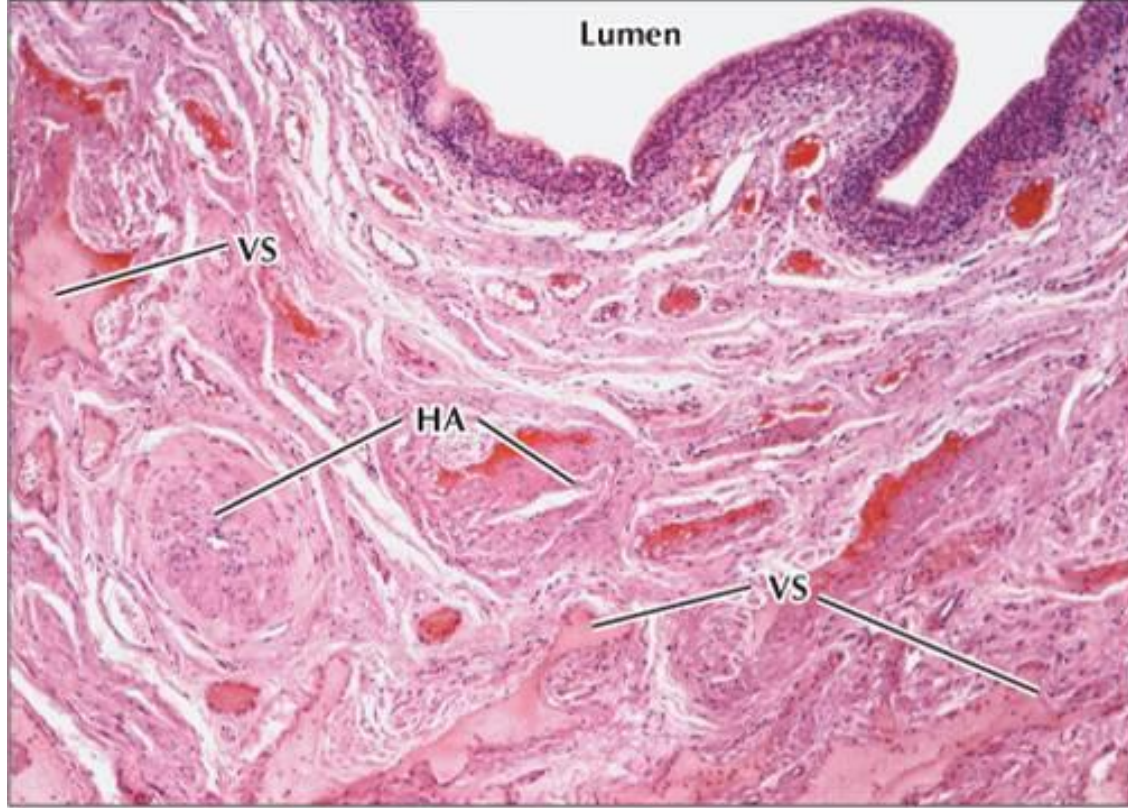
LM of the penis in transverse section. The shaft comprises two corpora cavernosa and a corpus spongiosum. This section lacks overlying epidermis. 1.6x. H&E.



LM of the corpus spongiosum in the penis. Epithelium lining the urethral lumen is highly folded; underlying lamina propria is richly cellular and vascular. A gland of Littre with several mucous acini occupies the deeper lamina propria. Many thin-walled vascular channels (arrows) with irregularly shaped lumina are lined by endothelial cells and surrounded by dense irregular connective tissue. 70x. H&E.

LM of a gland of Littre in the penis. The secretory part of this tubuloacinar gland has an irregular shape. The lumen contains lightly eosinophilic precipitate (*). Columnar secretory cells line each acinus. Mucous cells have pale apical cytoplasm and one basal nucleus. Glandular secretions drain by ducts in local recesses of the penile urethra lumen. 360x. H&E.

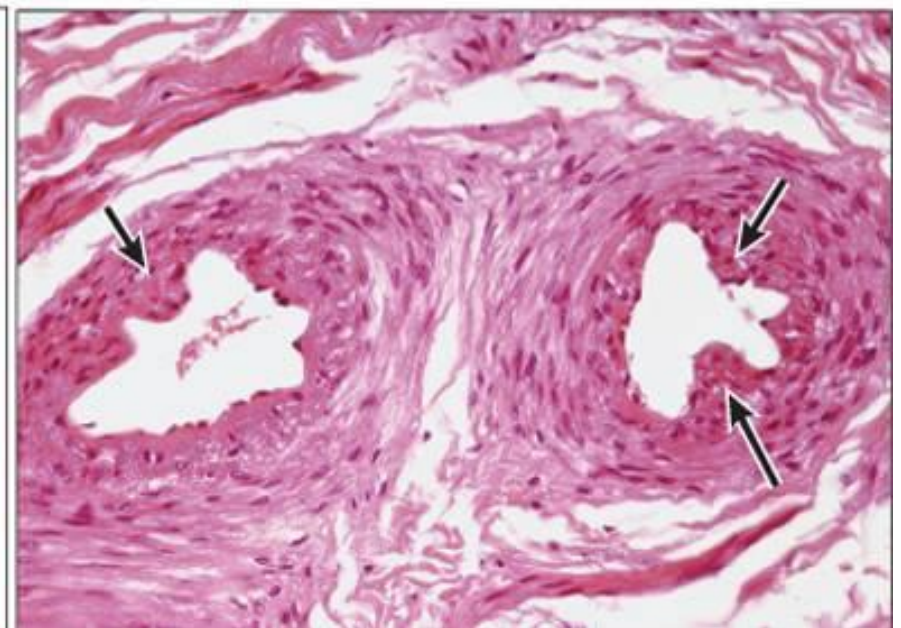
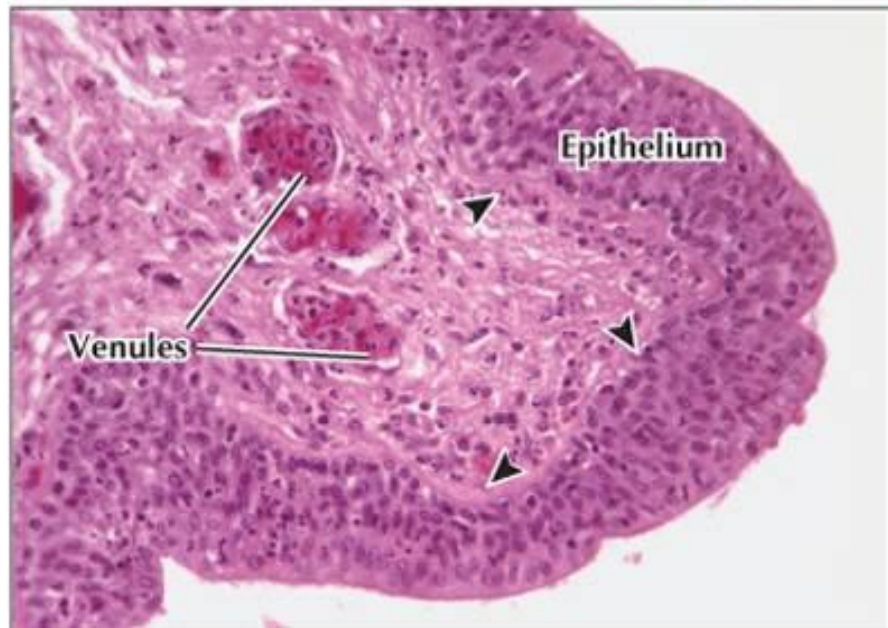


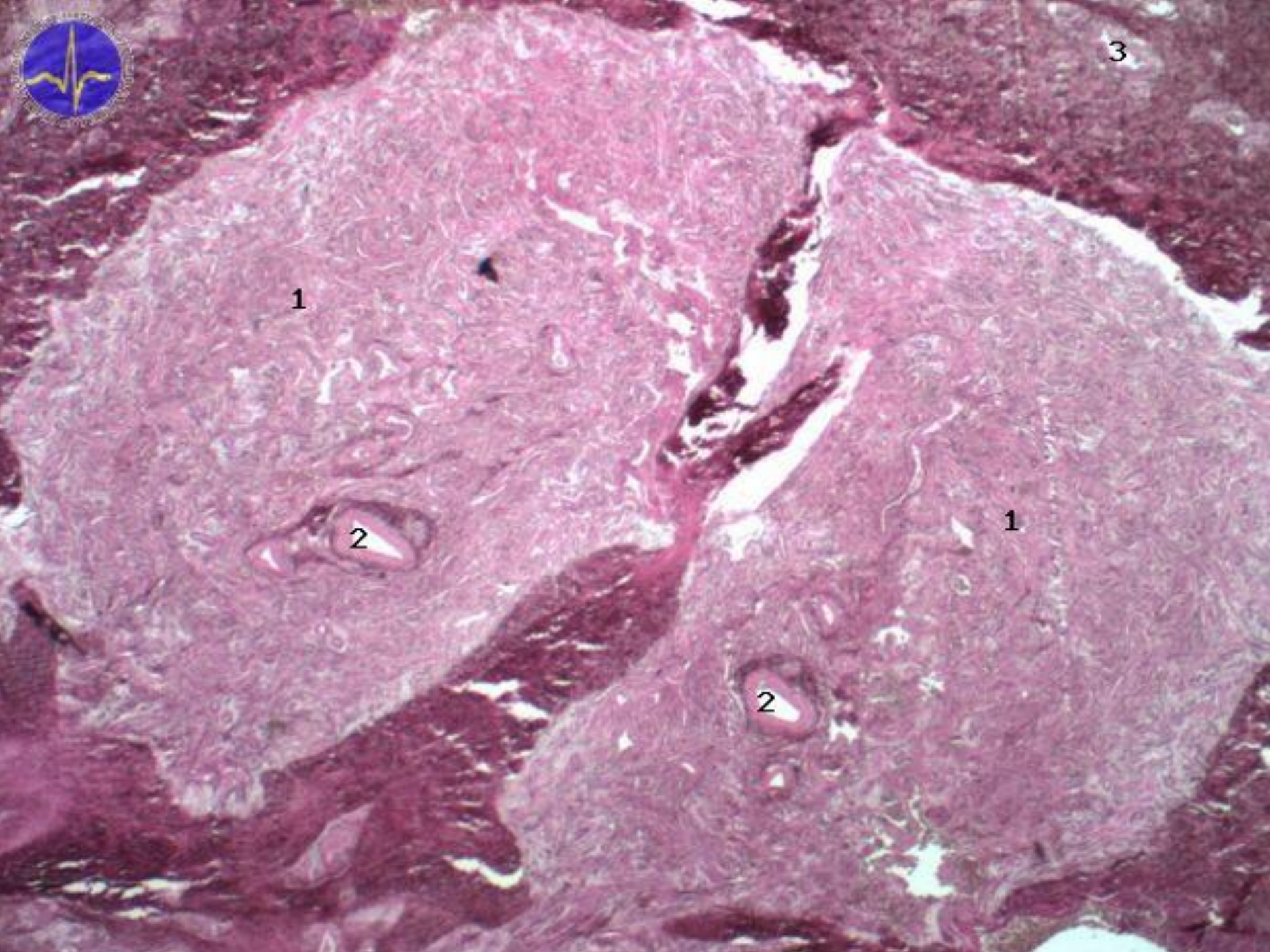


◀ **LM of the corpus spongiosum.** The mucosa lining the urethral lumen is corrugated. Erectile tissue in deeper layers contains helicine arteries (**HA**), veins, and venous sinuses (**VS**). 110×. H&E.

▶ **LM of the penile urethra at higher magnification.** The stratified columnar nature of the epithelium, with an underlying basement membrane (**arrowheads**) is clear. The lamina propria is loose connective tissue and contains several venules close to the surface. 400×. H&E.

▼ **LM of helicine arteries in the corpus spongiosum.** These highly coiled arterioles have a thick tunica media with an inner layer of longitudinally oriented smooth muscle that forms thickenings (**arrows**) of tunica intima. Contraction of this smooth muscle constricts the arteriolar lumen. These arteries drain directly into venous sinuses. 300×. H&E.





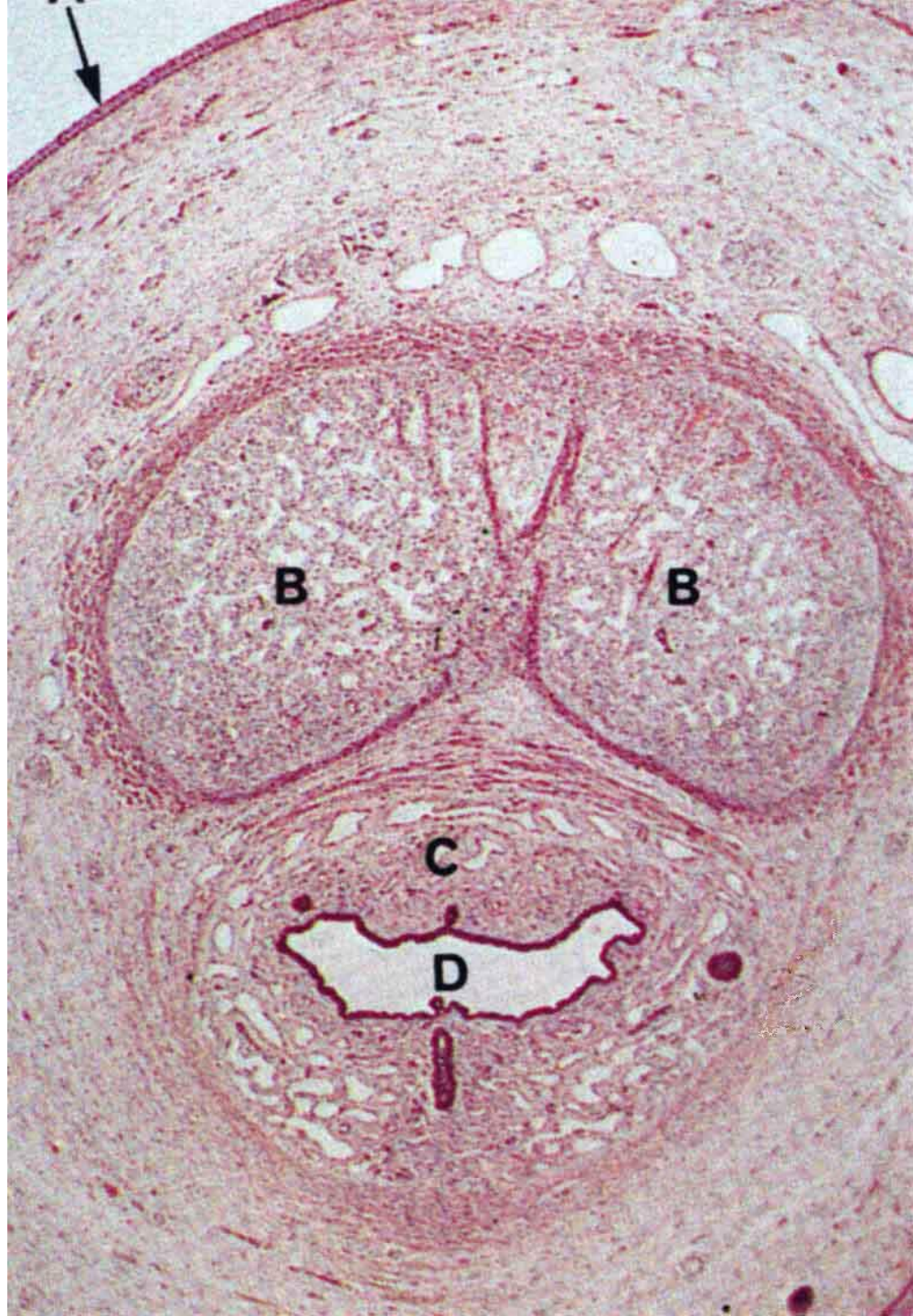
1

2

1

2

3



Erection (*Erectio*)

- sexual stimulation (cortex → hypothalamus → spinal cord → ↑ tone of parasympathetic system → Onuf's nucleus → n. pudendus → n. dorsalis penis → NO production → relaxation of smooth muscle cells within the sinusoid wall + ↓ tone of von Ebner's cushions → compression of efferent venules → erection → phosphodiesterase cleaves cGMP → erection termination)
- sildenafil (*Viagra*) inhibits phosphodiesterase

Semen

- 2-5 ml of ejaculate
- cell component: approximately 80-200 millions of sperms
- liquid component
- pH 7.2-7.8

- normal spermiogram (WHO 2010)
 - total mobility over 40%
 - > 4% normal forms of sperms
 - > 15 milion per 1 ml

Scrotum

- features: raphe, septum (complete)
- wall: derivatives of abdominal wall + tunica dartos
- thin pigmented skin without adipocytes
- sebaceous and sweat cells
- layer of myofibroblasts in dermis → contraction
- arteries:
 - a. femoralis → aa. pudendae externae
 - a. iliaca int. → a. pudenda interna
 - a. cremasterica for covers
- veins:
 - vv. scrotales ant. → v. femoralis
 - vv. scrotales post. → v. pudenda interna

Scrotum

innervation and lymph drainage

Nerves:

- anterior 1/3 – n. ilioinguinalis + r. genitalis
n. genitofemoralis
- zadní 2/3 – n. pudendus + n. cutaneus
femoris post.

Lymph: n.l. inguinales superficiales

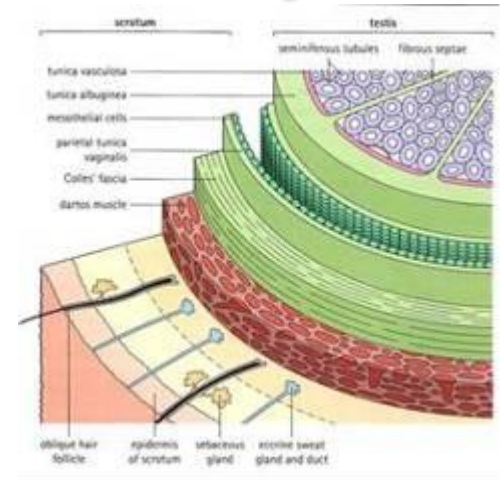
!!! never perform puncture of testis !!!

– danger of **tumor cell spread** into the
different tributary area of lymph nodes !!!

Abdominal wall x Scrotum layers

- skin
- Camper's fibrous layer
- fascia abd. subcutanea *Scarpae*
- fascia abd. superficialis
- mm. abdominis
- fascia transversalis
- peritoneum

- skin
- tunica dartos
- fascia spermatica ext.
- m. cremater + f. cremasterica
- fascia spermatica int.
- tunica vaginalis testis
 - lamina parietalis = periorchium
 - lamina visceralis = epiorchium



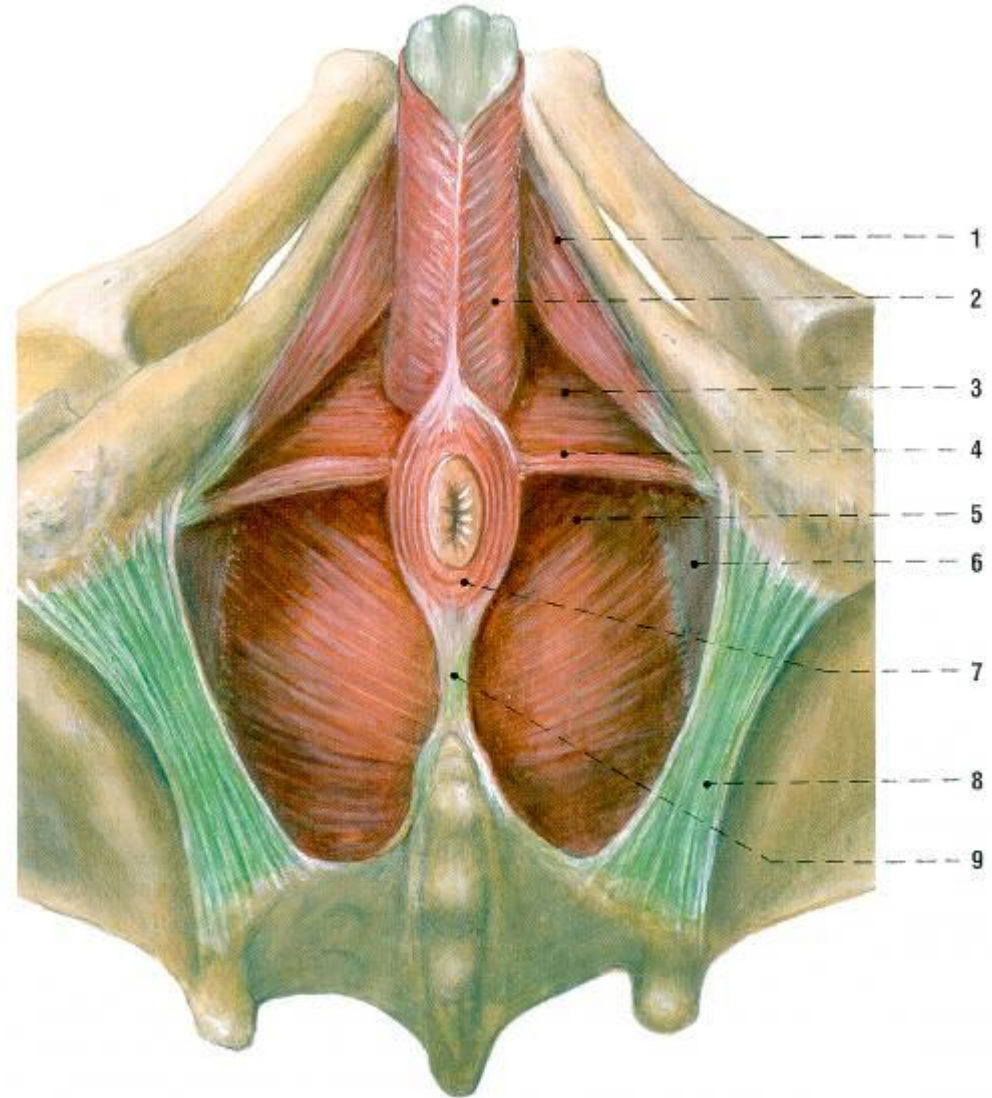
Urogenital floor

- = diaphragma urogenitale
- **not a term** of Terminologia Anatomica 1998
- suitable for clarity
- **perineal muscles = *musculi perinei*** following TA 1998
- 4 muscles in a plane = „floor“
- + 1 ♂ other muscle around urethra
- corpus perineale is in its center

Svaly dna pánevního a mčopohlavního muže žabí perspektiva



- m. transversus perinei profundus
- m. transversus perinei superficialis
- m. bulbospongiosus
- m. ischiocavernosus
- m. sphincter urethrae externus



1 m. ischiocavernosus
2 m. bulbospongiosus
3 diaphragma urogenitale
4 m. transversus perinei superficialis

5 m. levator ani
6 m. obturatorius internus a jeho fascie
7 m. sphincter ani externus
8 lig. sacrotuberale
9 lig. anocecygeum

Perineal muscles – *innervation*

spinal nerve S4

- nn. perineales n. pudendi
- rr. anteriores nn. sacralium
- nn. splanchnici sacrales

