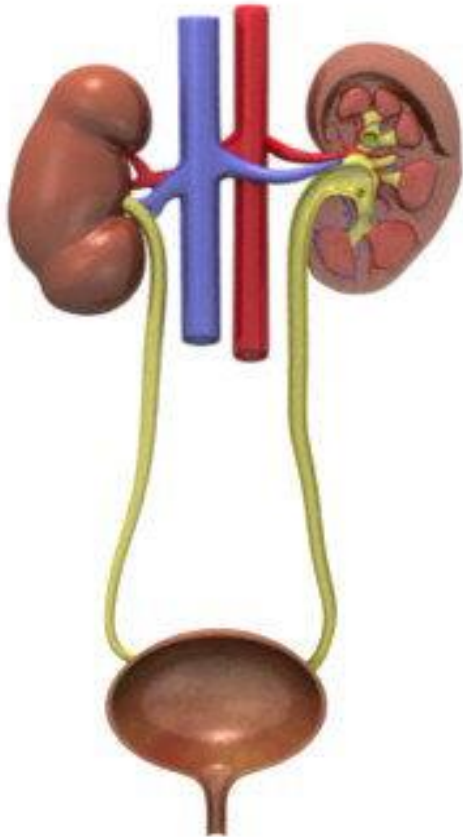


URINARY SYSTEM

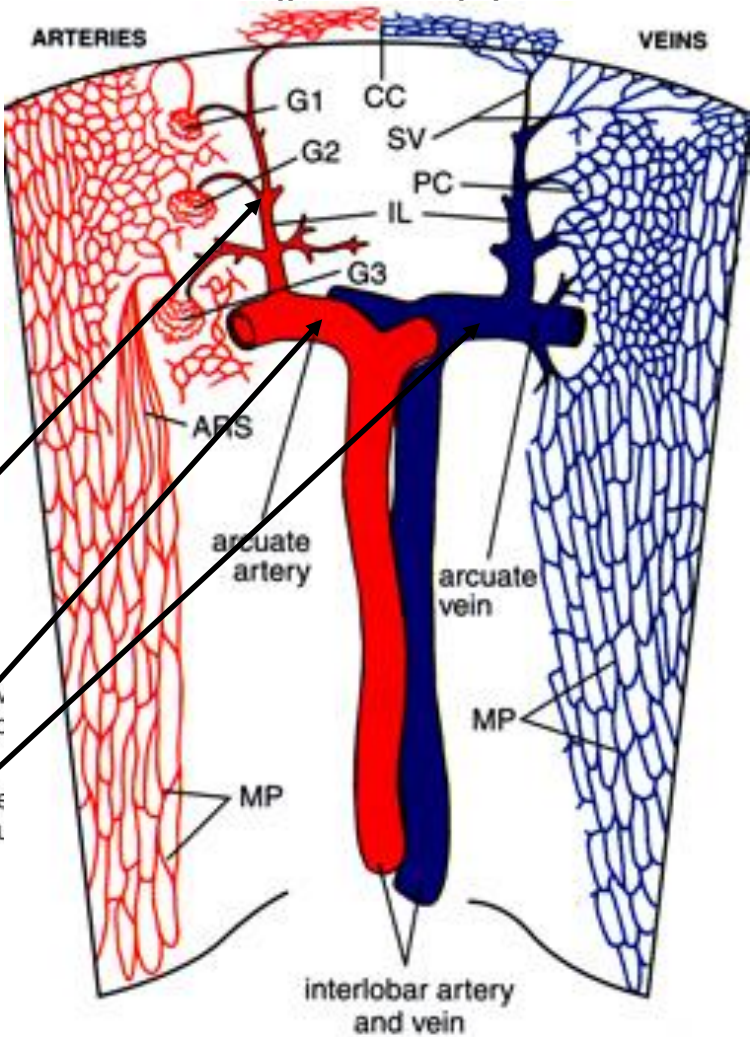
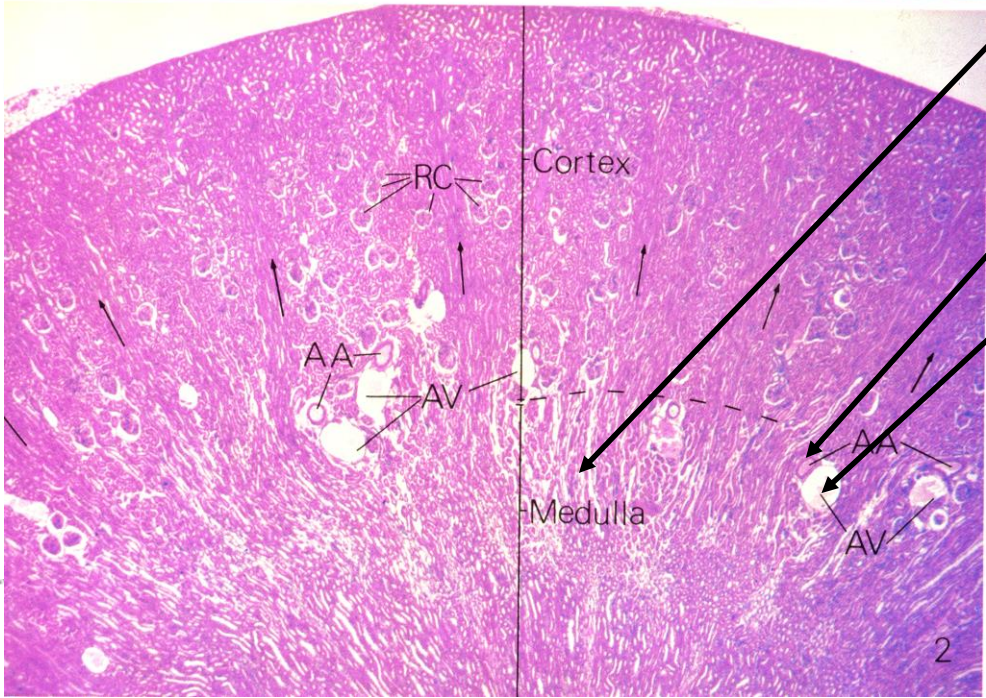
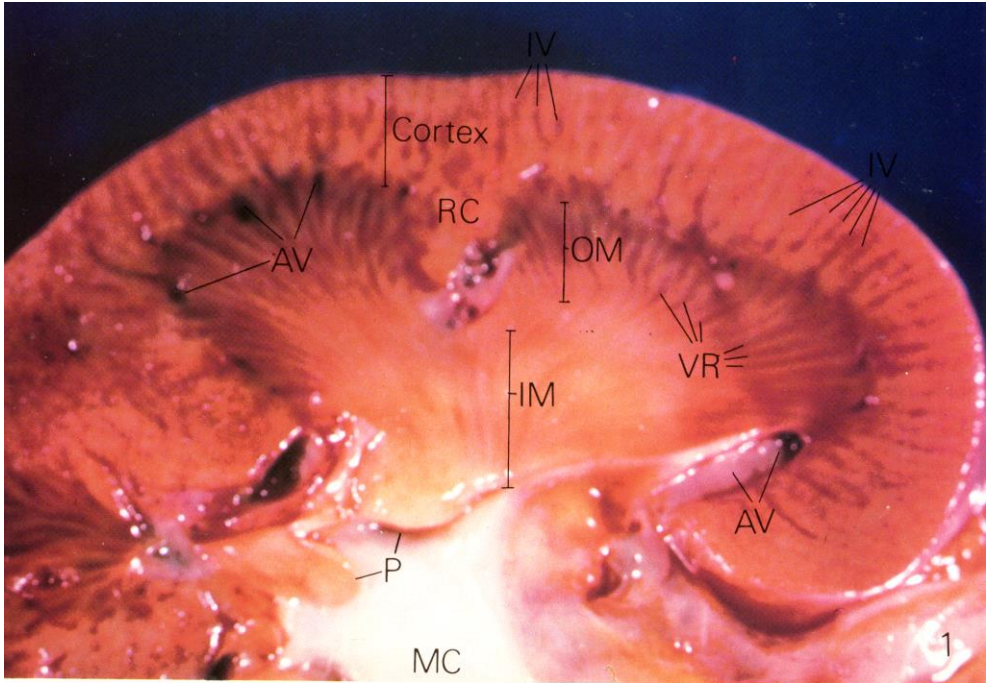


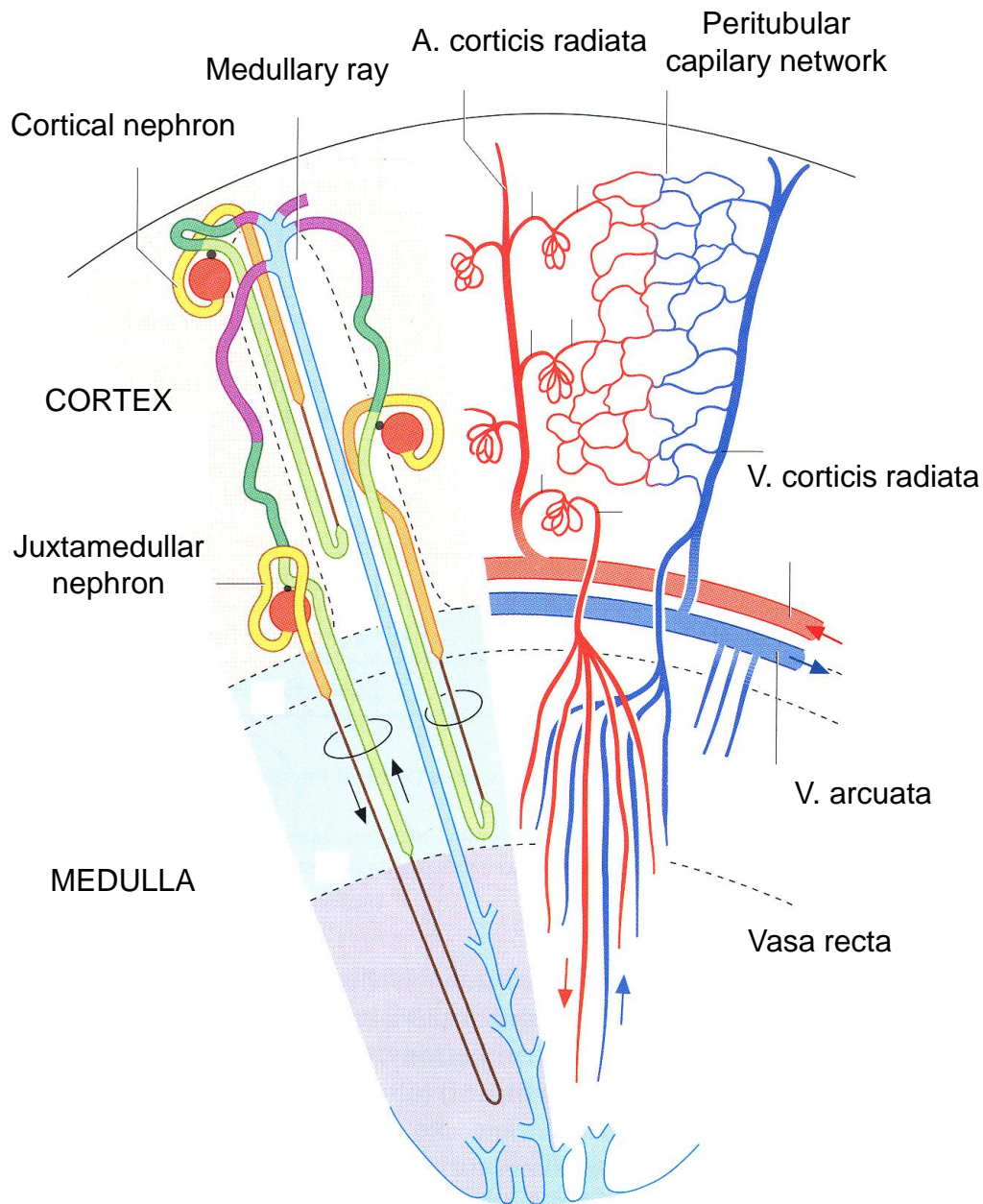
- **Ren (kidney)**
- **Excretory passages**
 - calyx renalis
 - pelvis renalis
 - ureter
 - vesica urinalis
 - urethra

Kidney (ren, nephros)

Cortex:

- cortex corticis





Blood supply:

- a. renalis
- aa. segmentales
- aa. interlobares
- aa. arcuatae
- aa. corticales radiatae
- aa. interlobulares

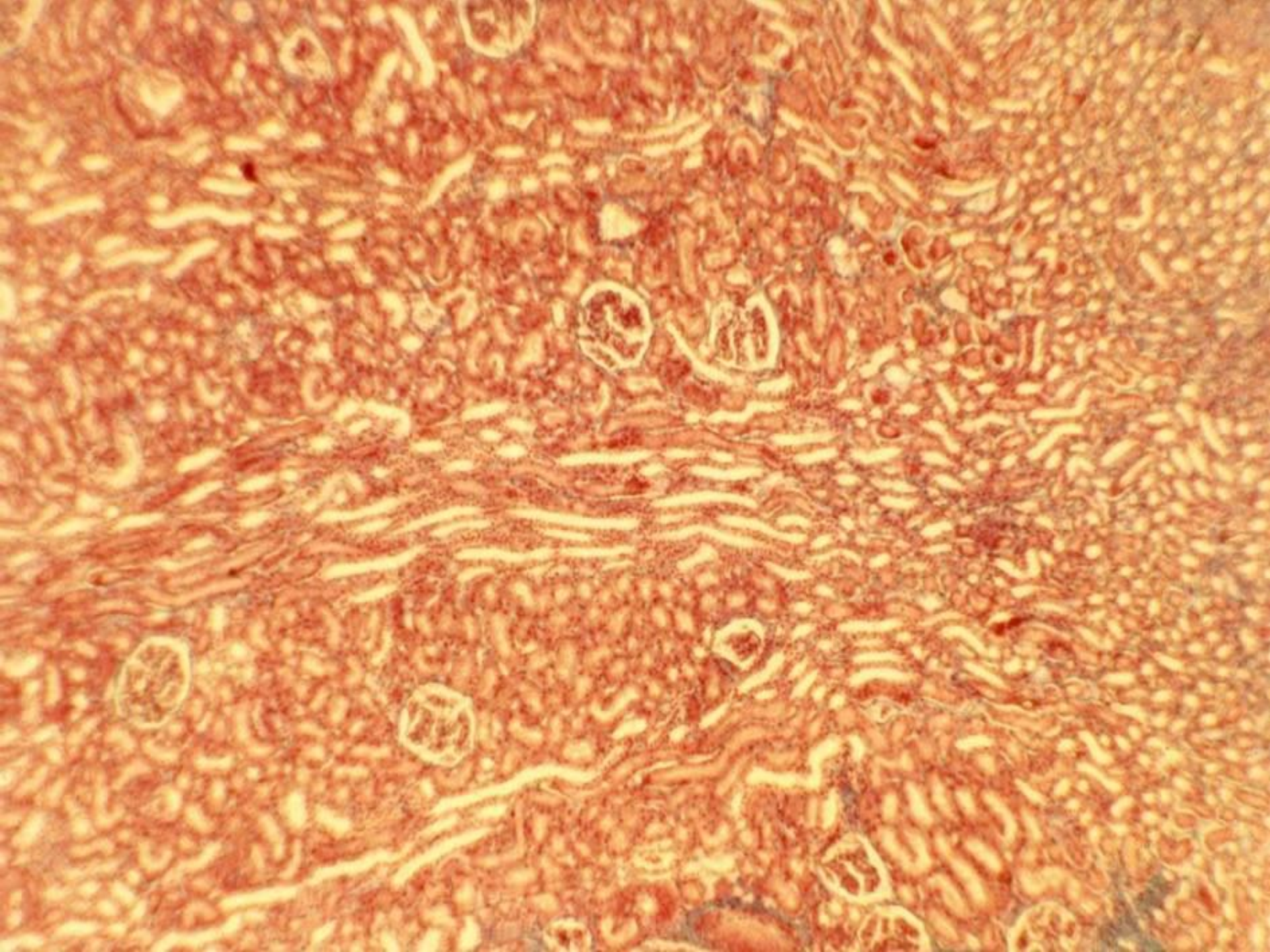
afferent arteriole

- glomerulus

efferent arteriole

- peritubular capillary network
- + vasa recta
- vv. corticales radiatae
- vv. interlobulares
- vv. arcuatae
- vv. interlobares
- vv. renales

(* portal circuit)



- **Functional secretory unit**

nephron

- **Excretory units**

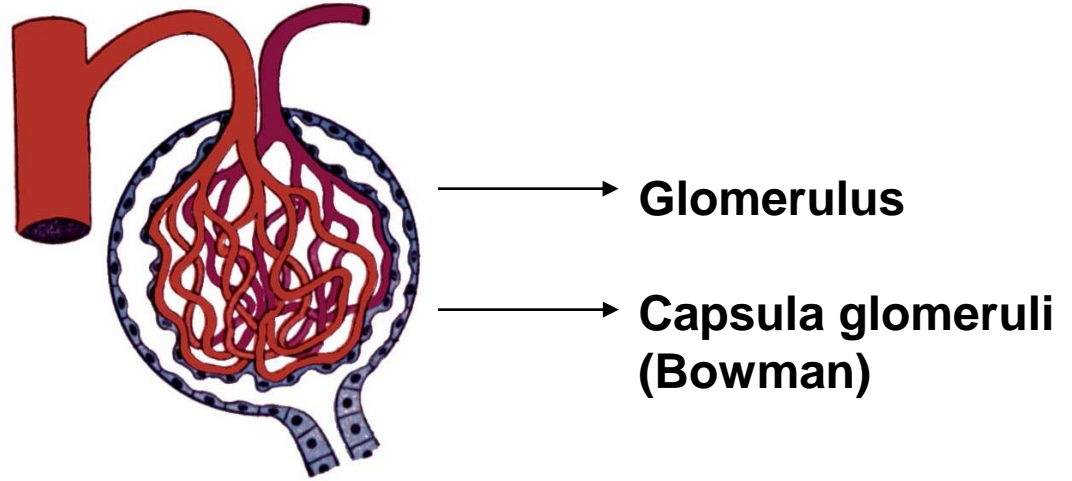
collecting ducts (tubulus et ductus colligens)

ductus papillares

Nephron

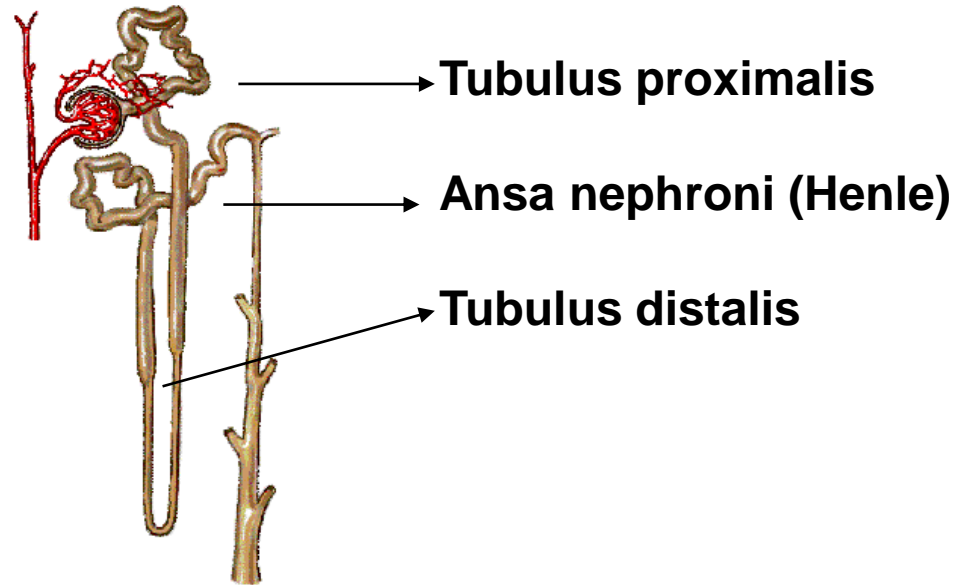
Renal corpuscle

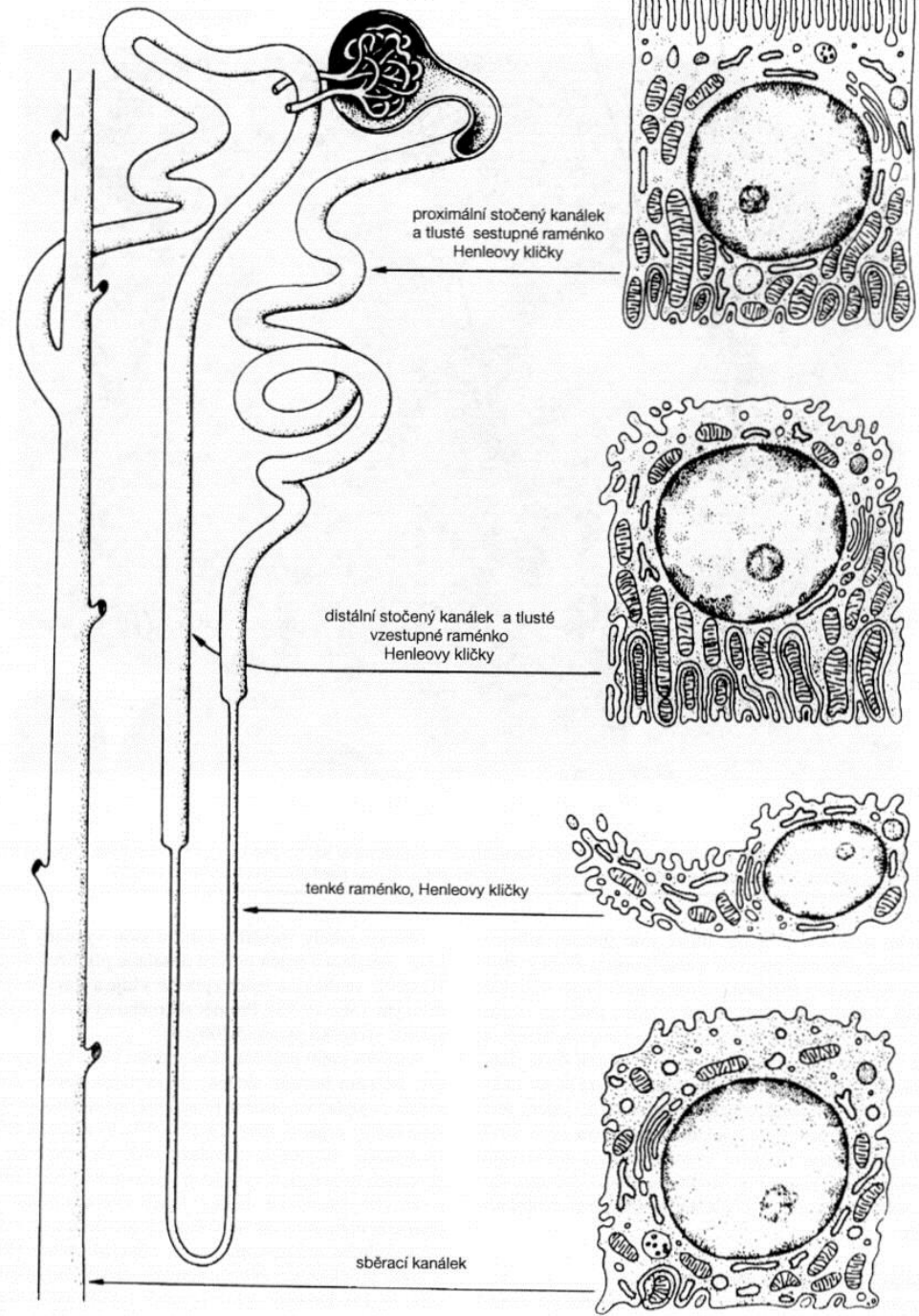
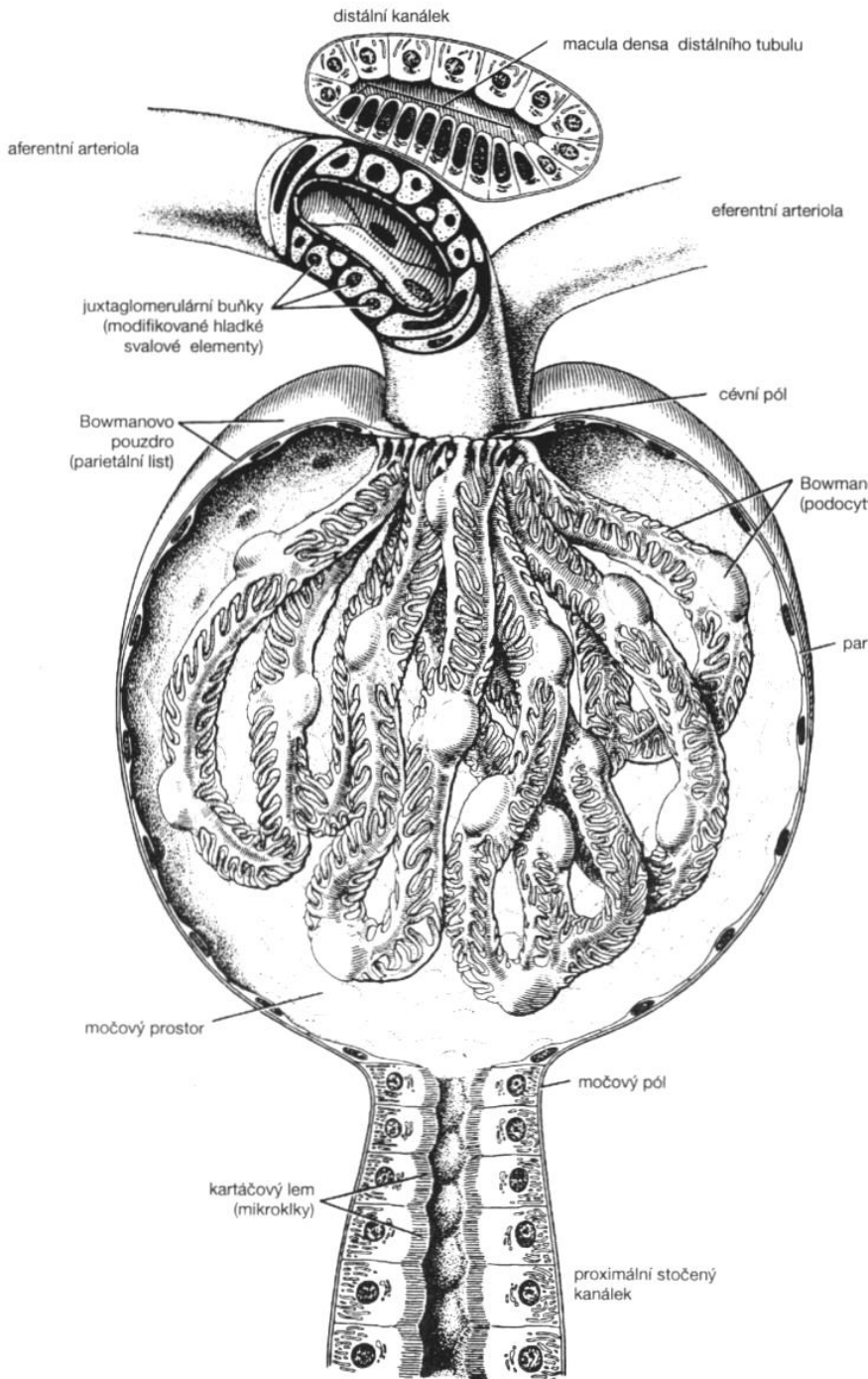
corpusculum renis
(*Malpighi*)



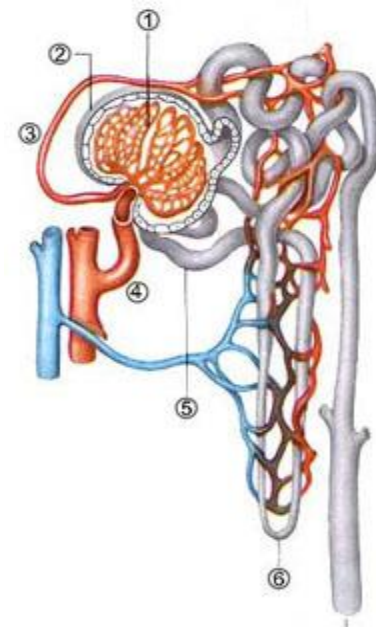
Renal (uriniferous) tubule

tubulus renis





Corpusculum renis (\varnothing 200 μm)



arteriola afferens + efferens

Vascular pole

Bowman's capsule:

parietal layer

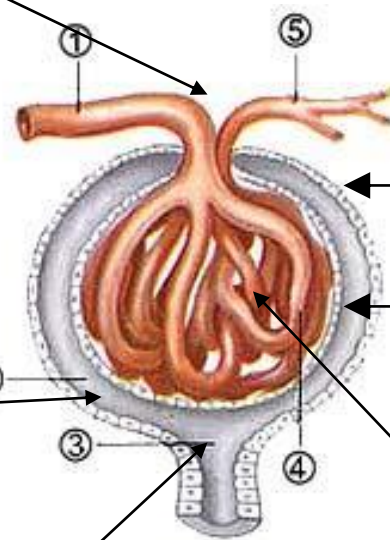
visceral layer

Urinary (Bowman's) space

Uriniferous pole

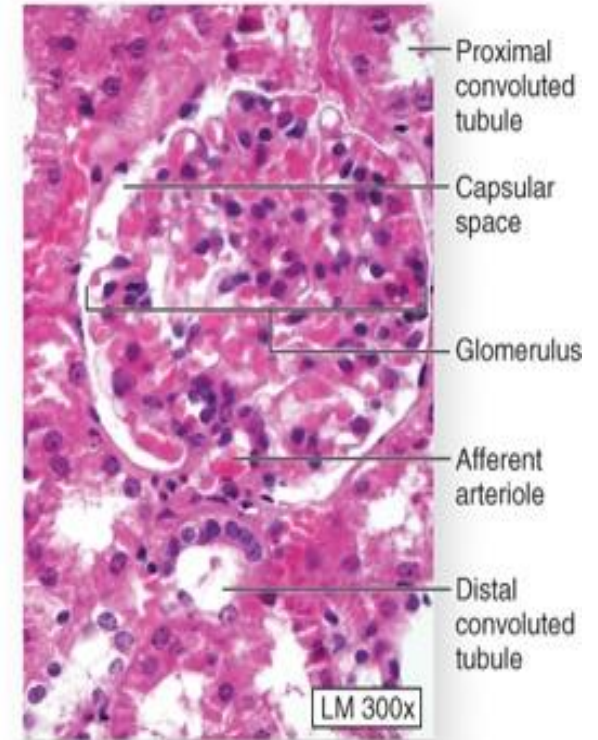
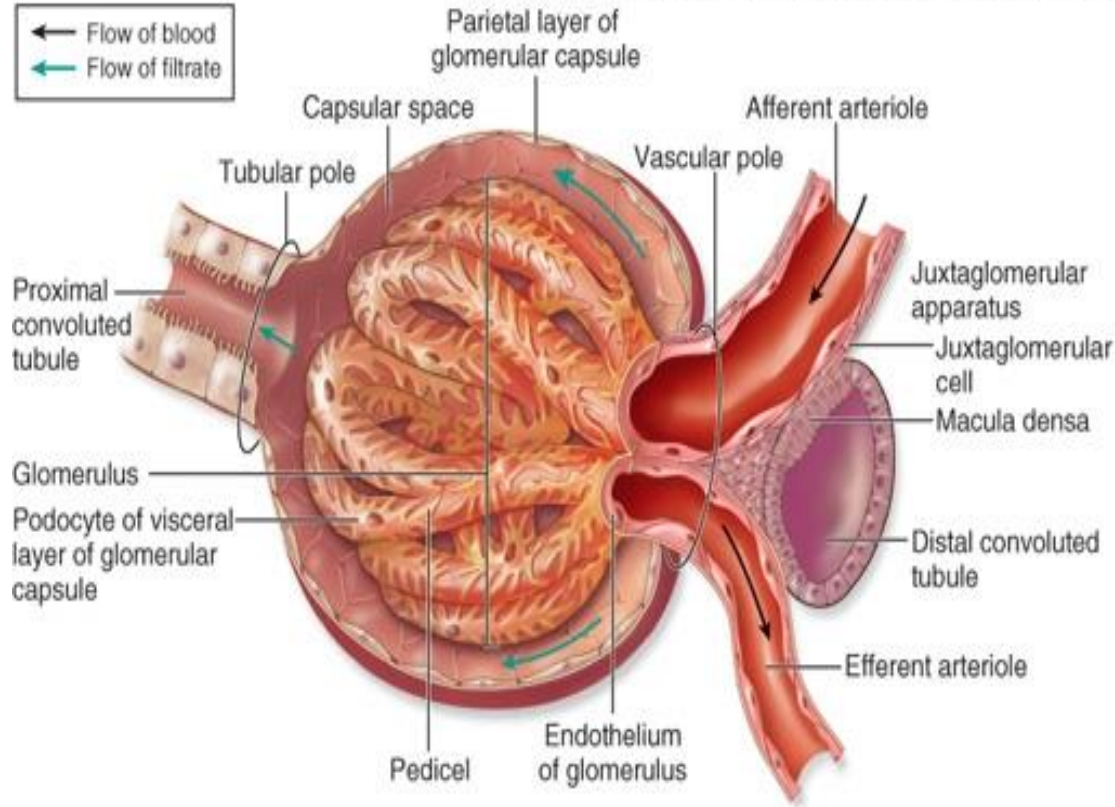
Glomerulus

+ mesangium



Corpusculum renis

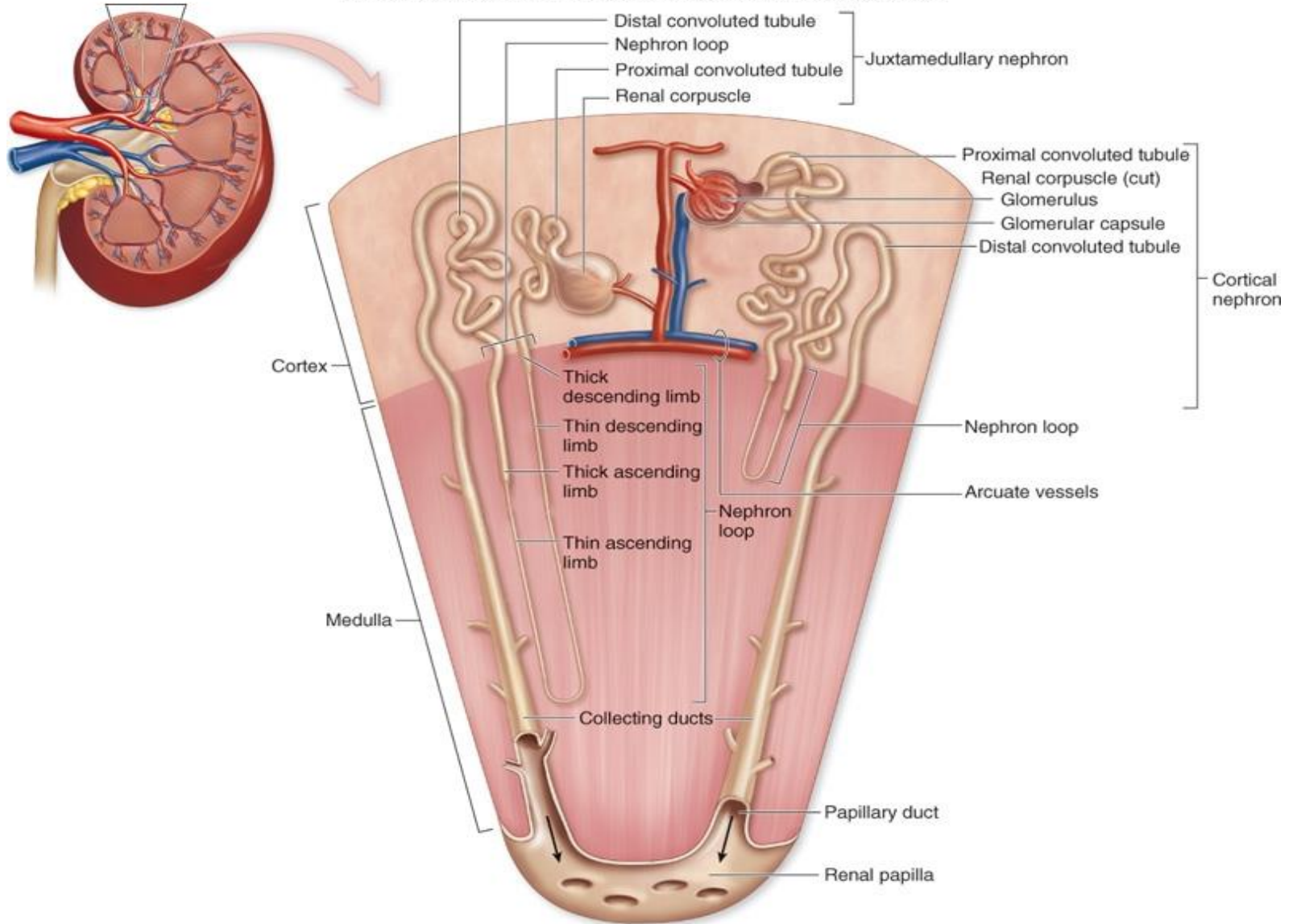
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



(a) Renal corpuscle

(b)

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



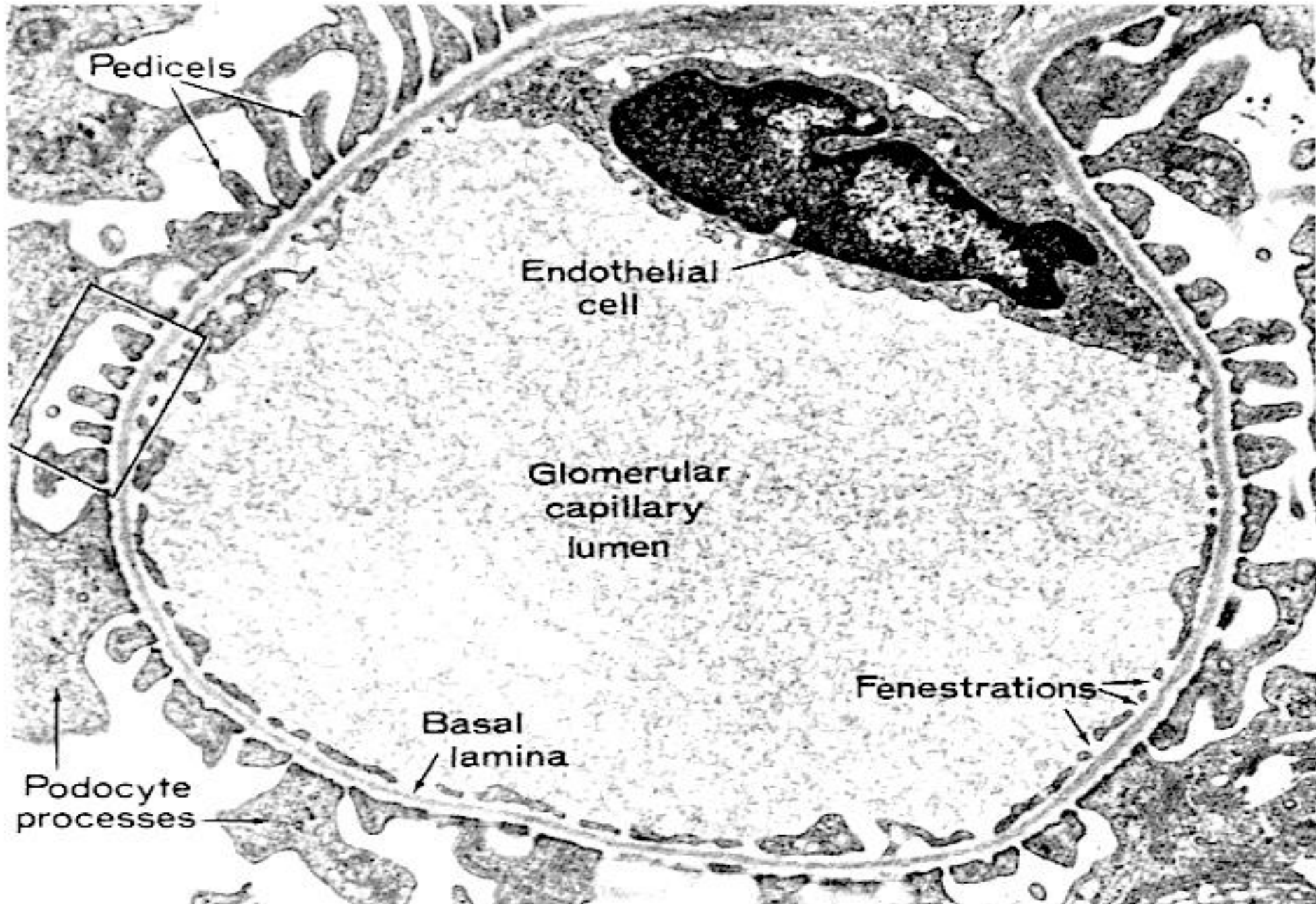
Filtration barrier

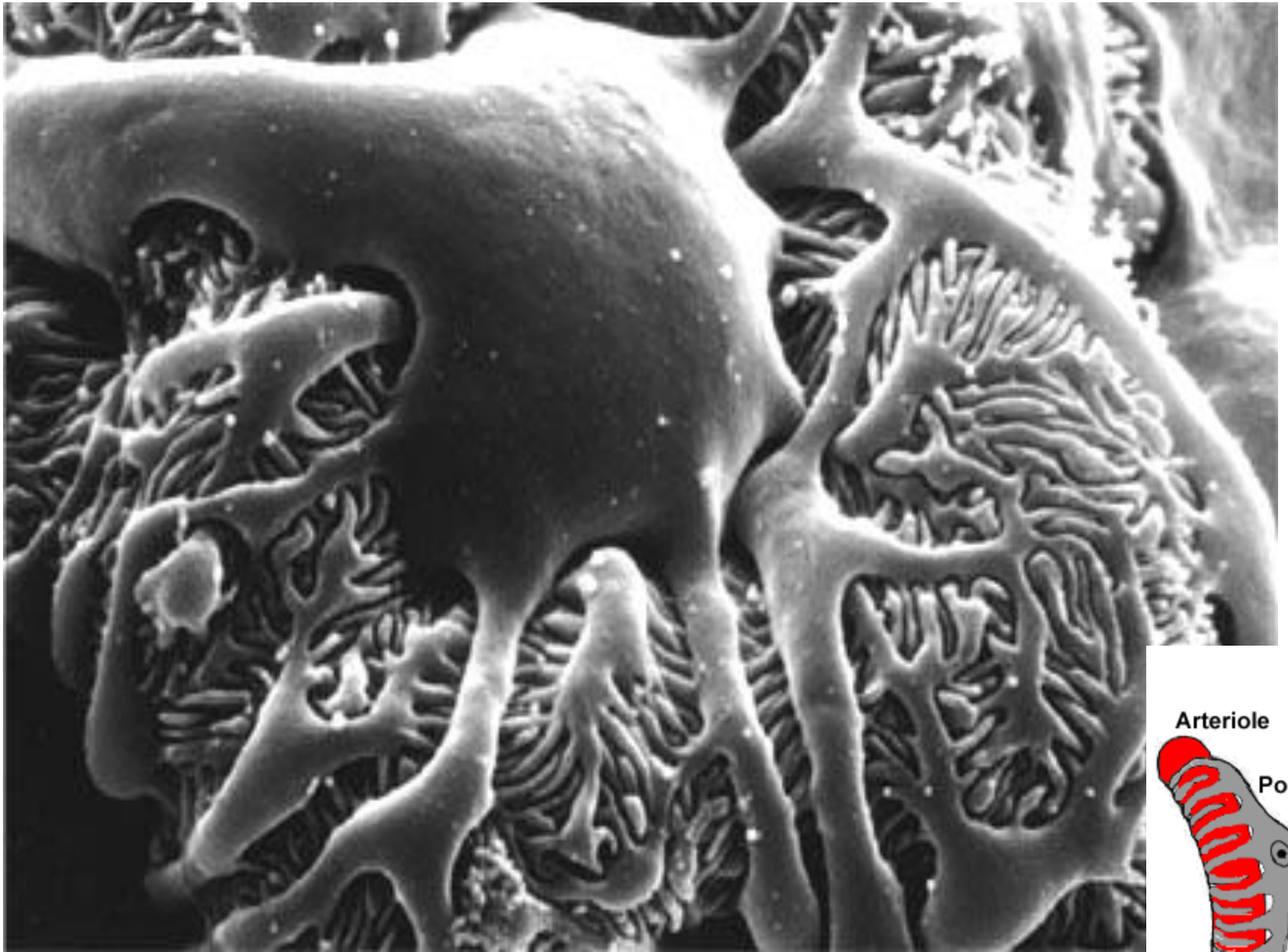
- **Glomerular endothelial cells** – fenestrations (pores) w/o diaphragm
- **Laminae basales** of endothelium and podocytes:
 1. lamina rara subendothelialis,
 2. lamina densa
 3. lamina rara subepithelialis

l. densa: collagen IV , l. rarae: heparansulphate

- **podocytes** – filtration slit membrane – similar to a diaphragm spanning fenestrations in normal capillaries

Filtration barrier

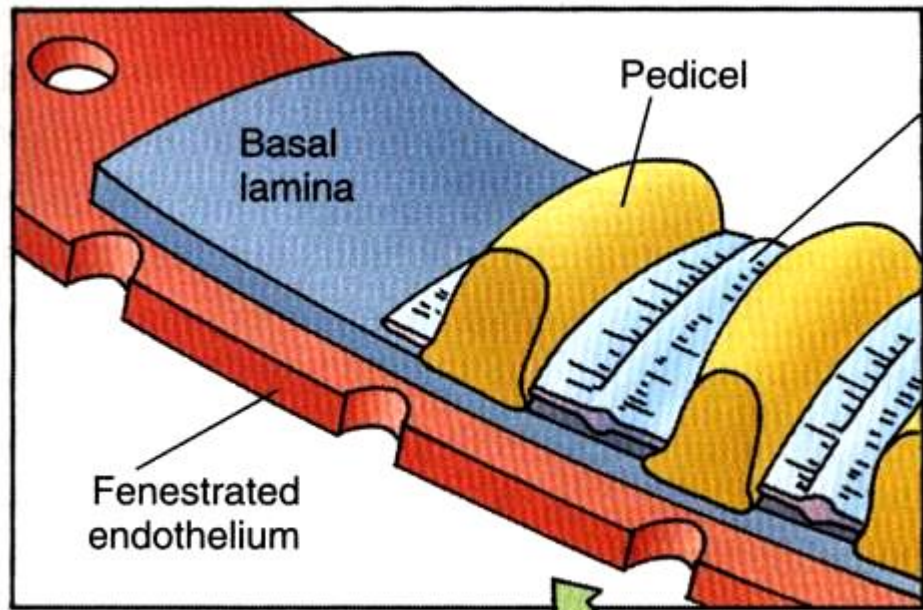




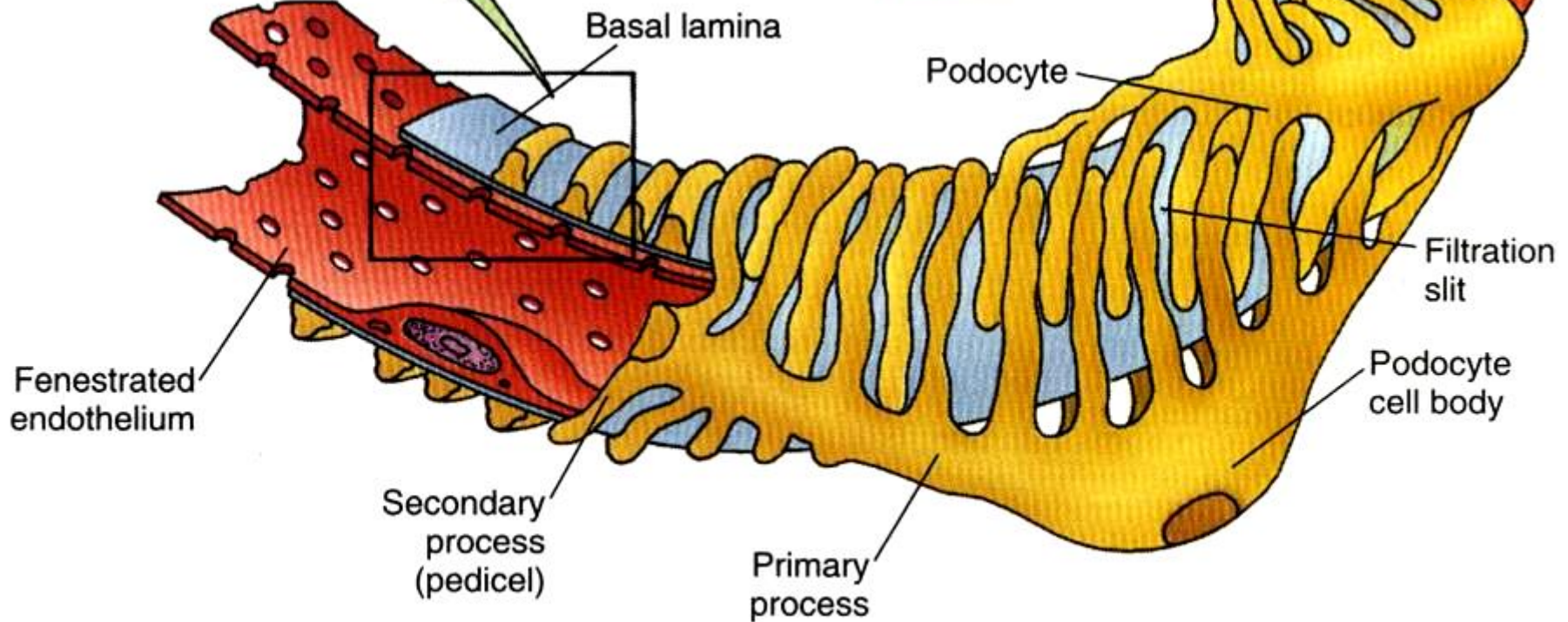
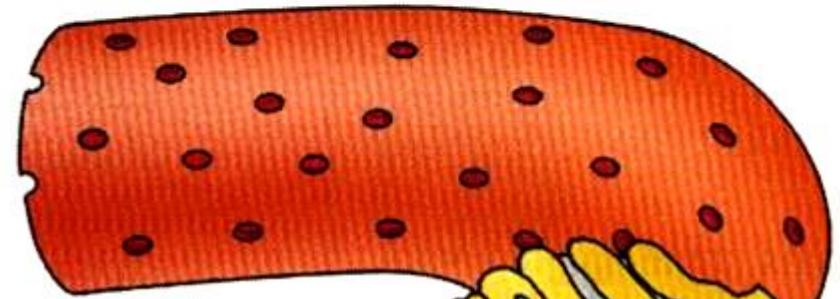
Arteriole

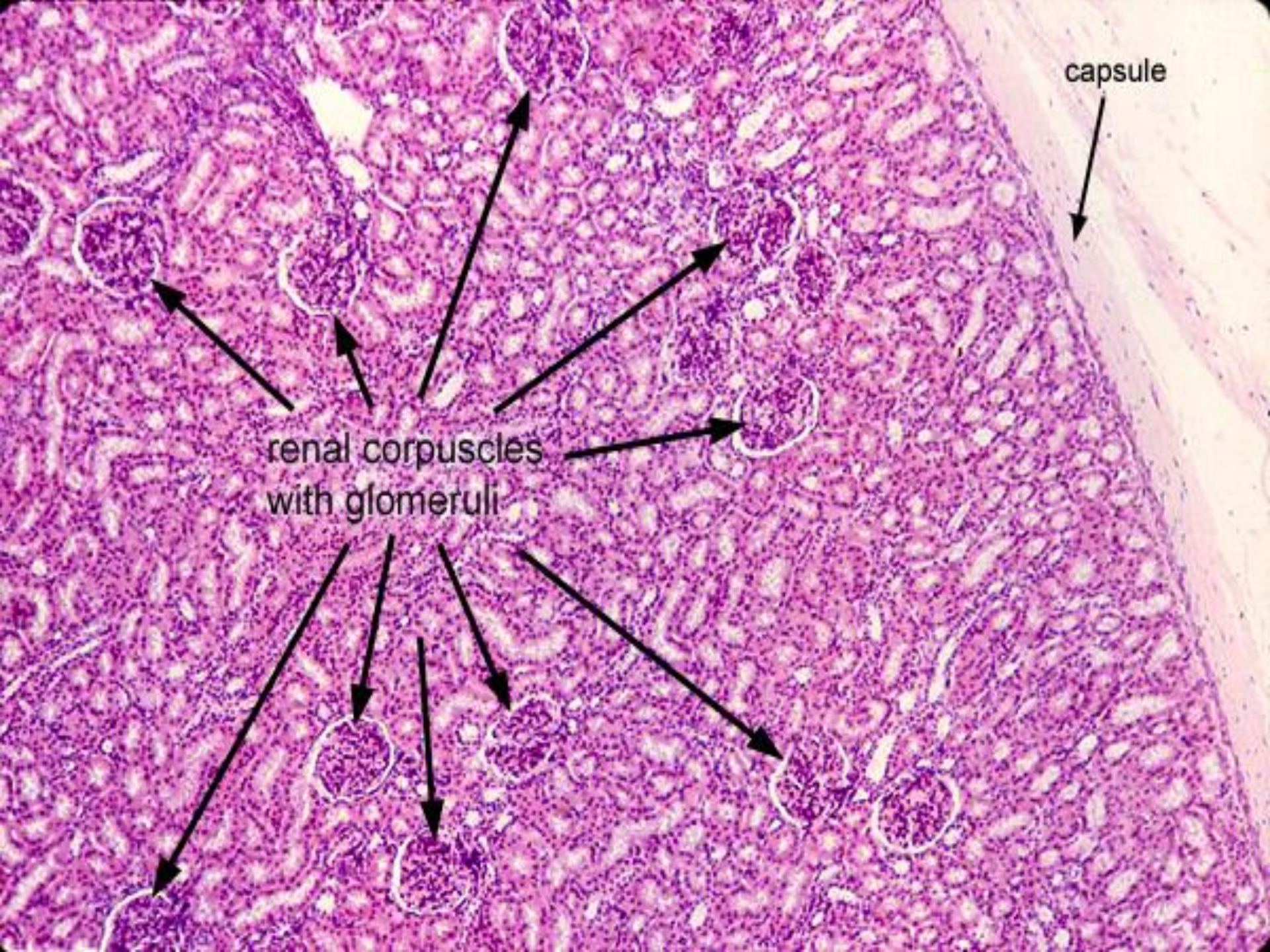
Podocyte





Filtration slit diaphragm
0,02 – 0,04 μm

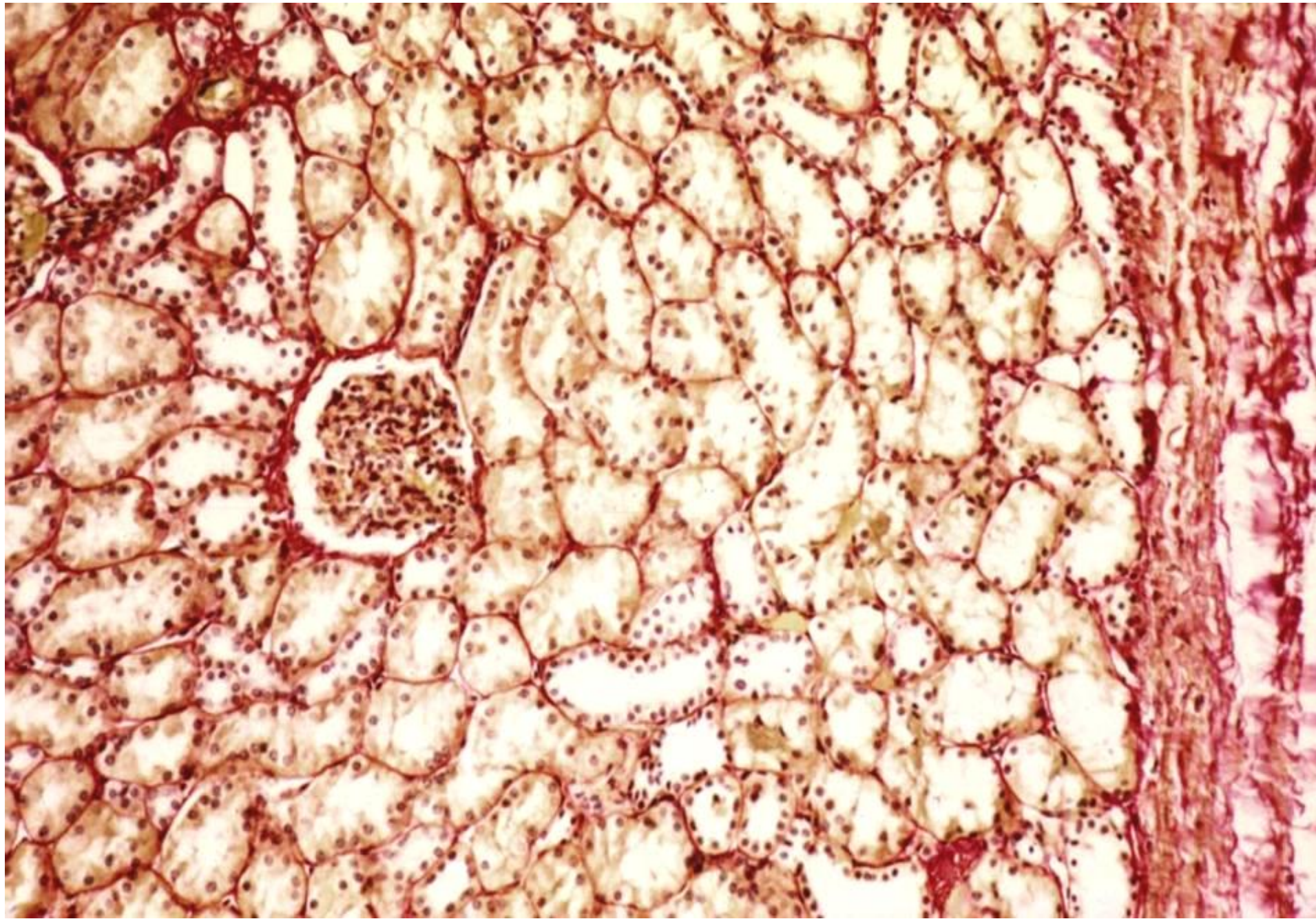


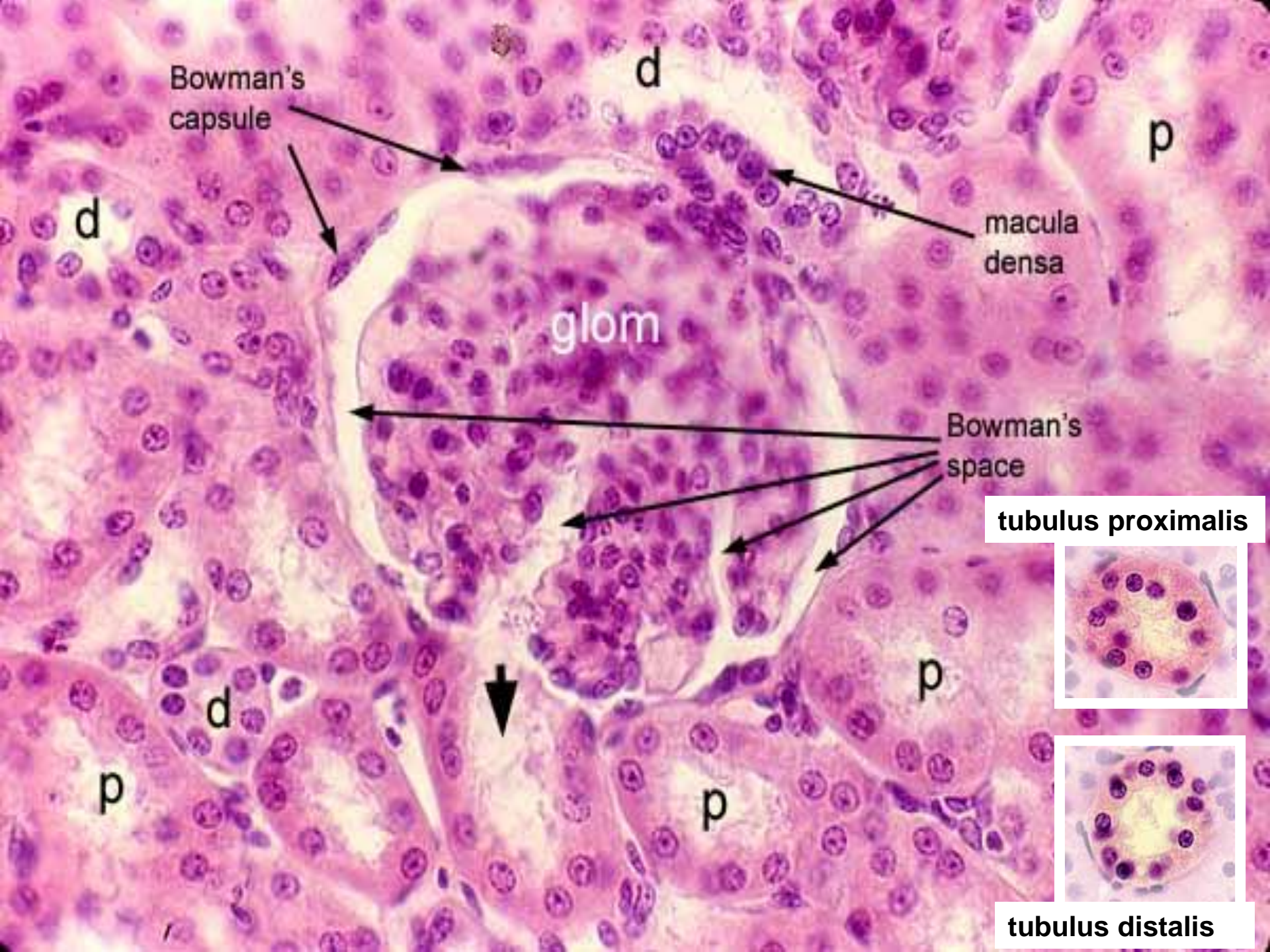


capsule

renal corpuscles
with glomeruli

Ren (Weigert-vanGieson)





Bowman's capsule

d

p

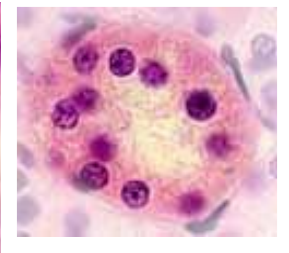
d

macula densa

glom

Bowman's space

tubulus proximalis

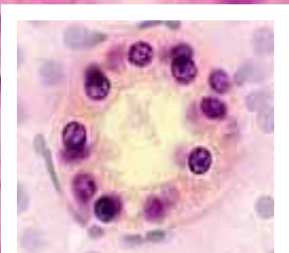


p

d

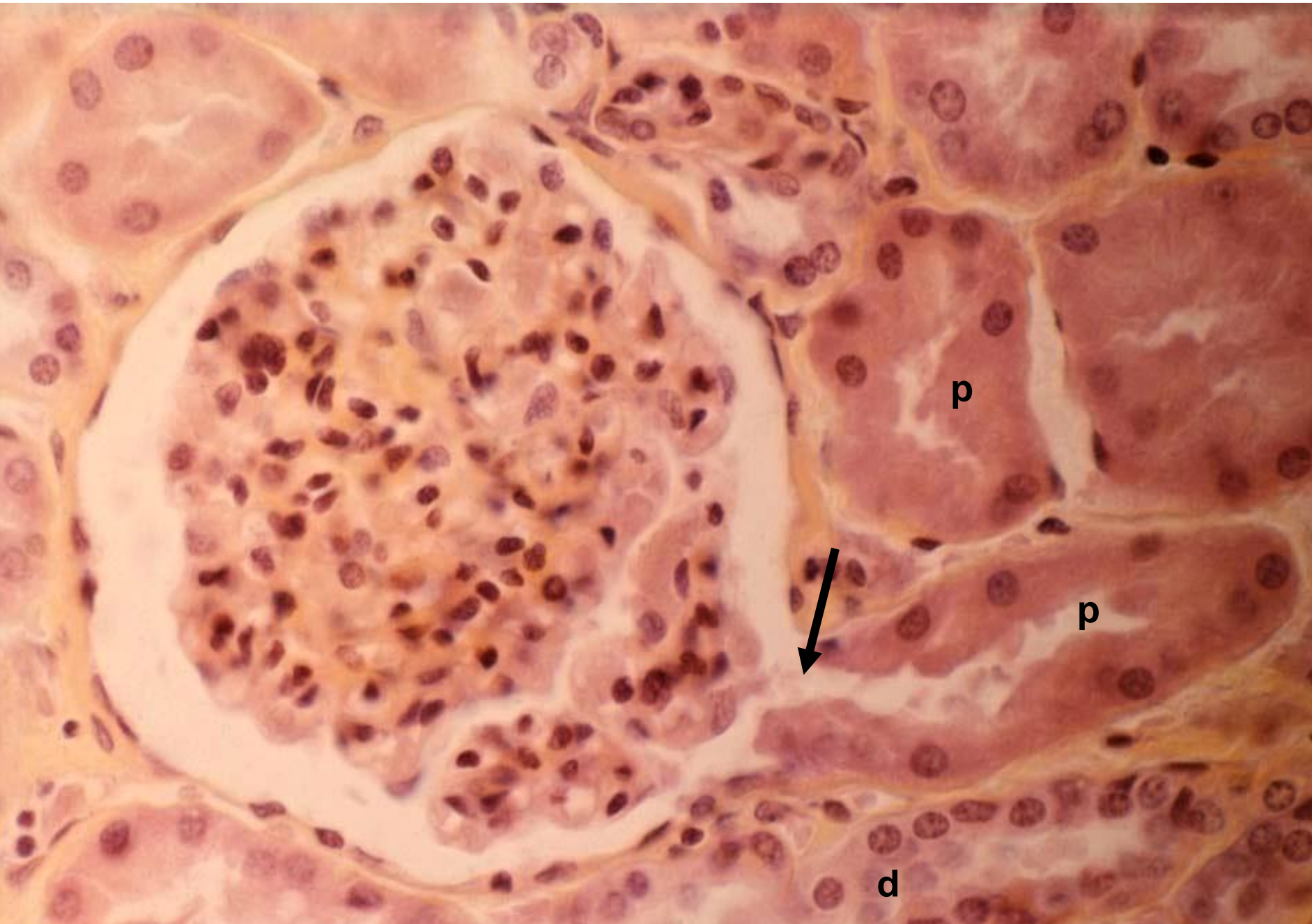
p

p

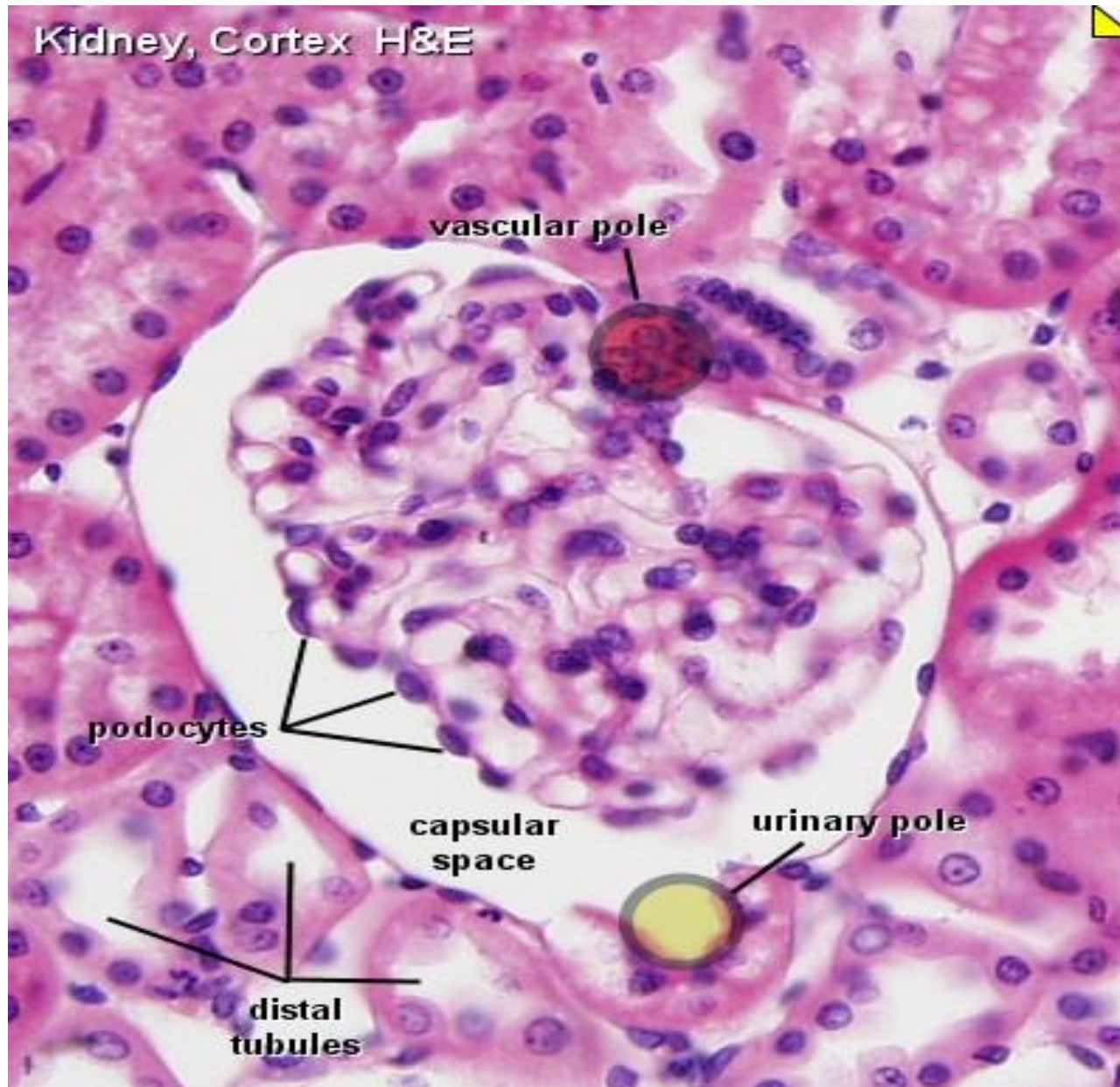


tubulus distalis

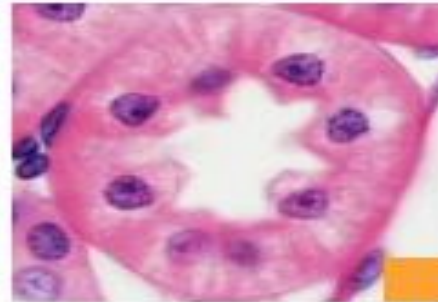
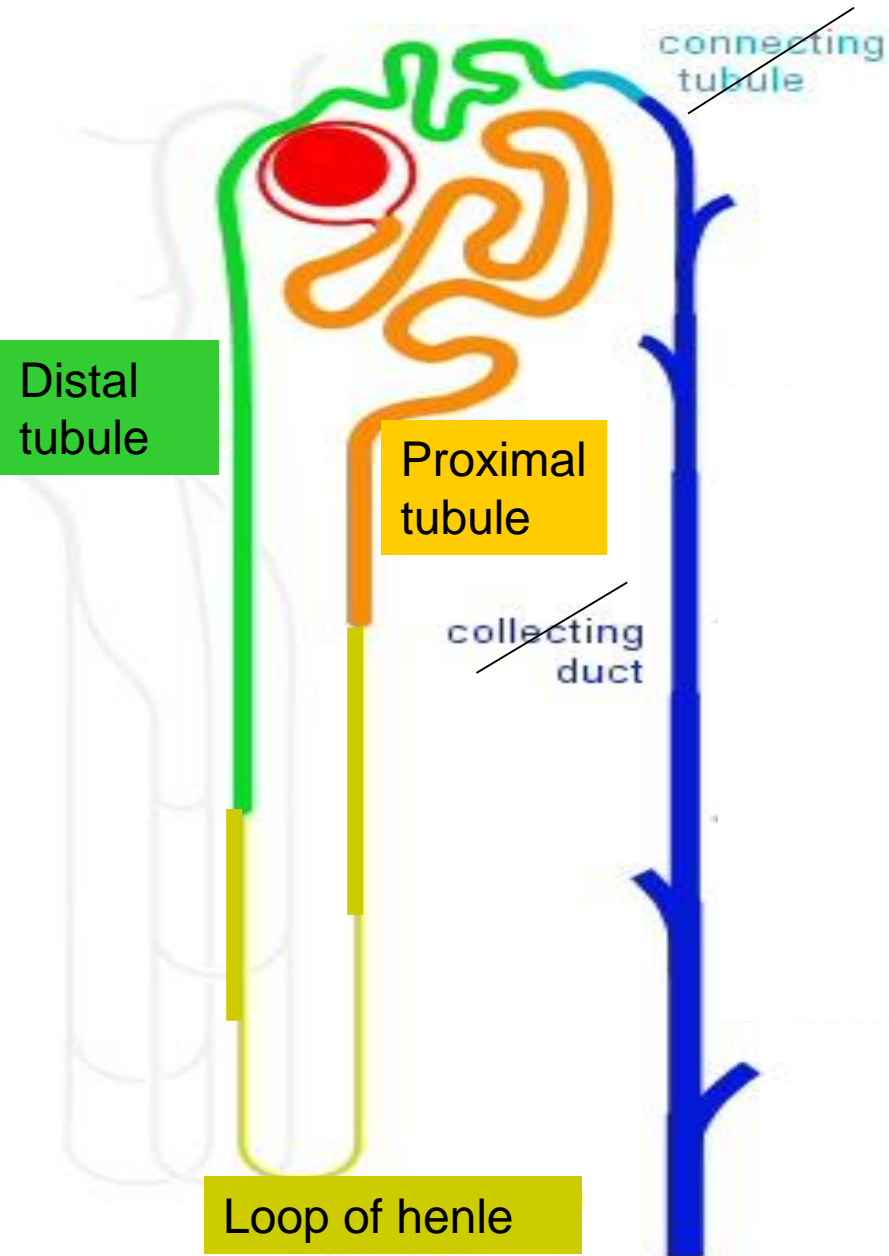
Ren (HE) – corpusculum renis, uriniferous pole ↓



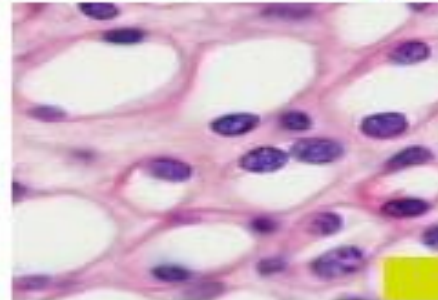
Ren (HE): corpusculum renis – vascular and uriniferous pole



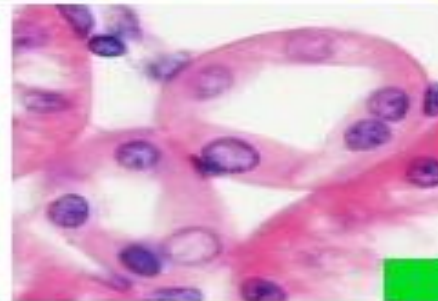
Tubulus renis



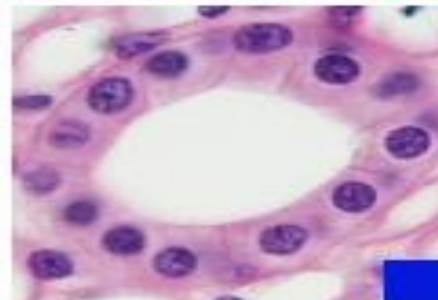
Simple columnar epithelium + brush border



Simple squamous epithelium (thin segment)

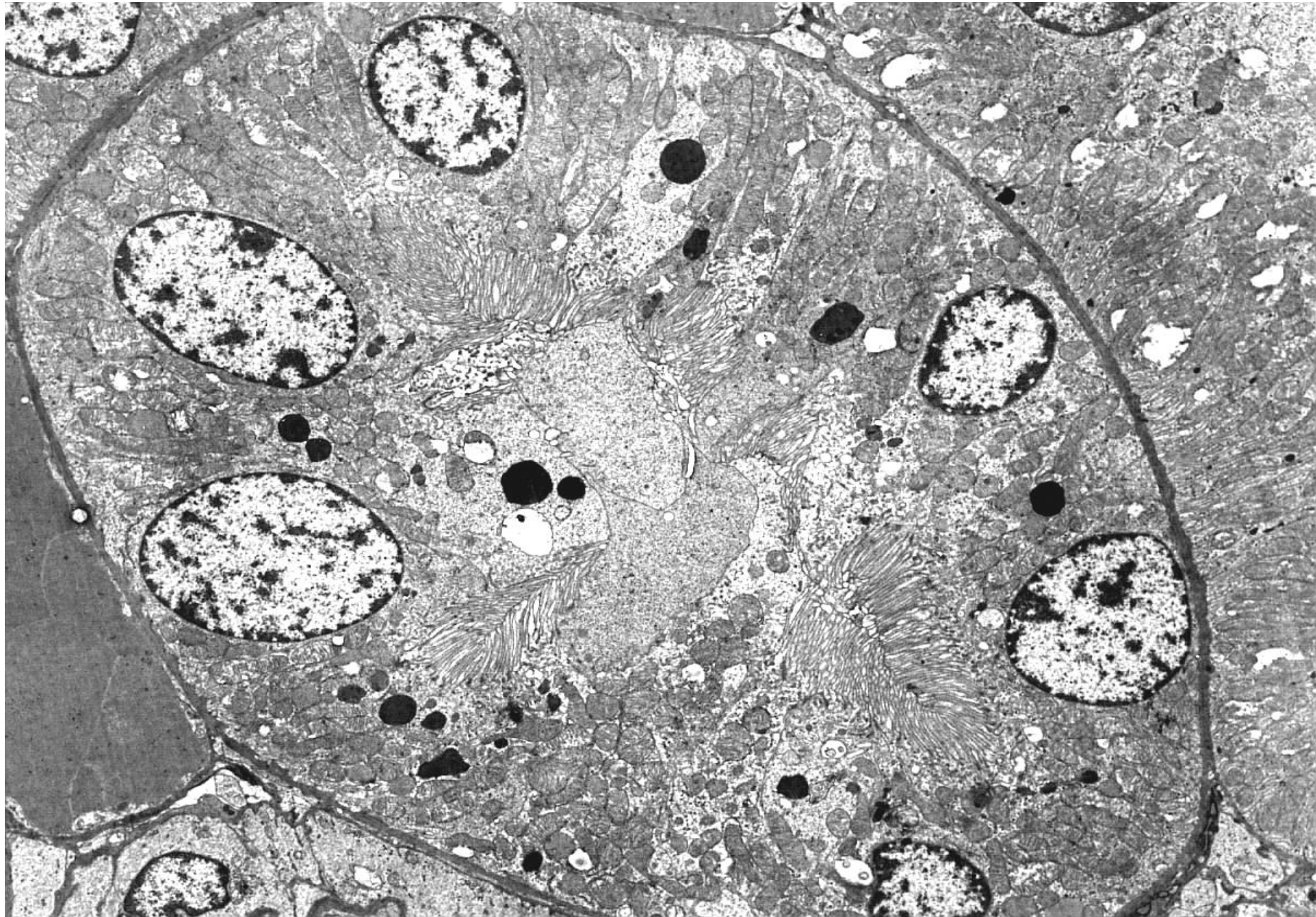


Simple cubic epithelium (thick segment)

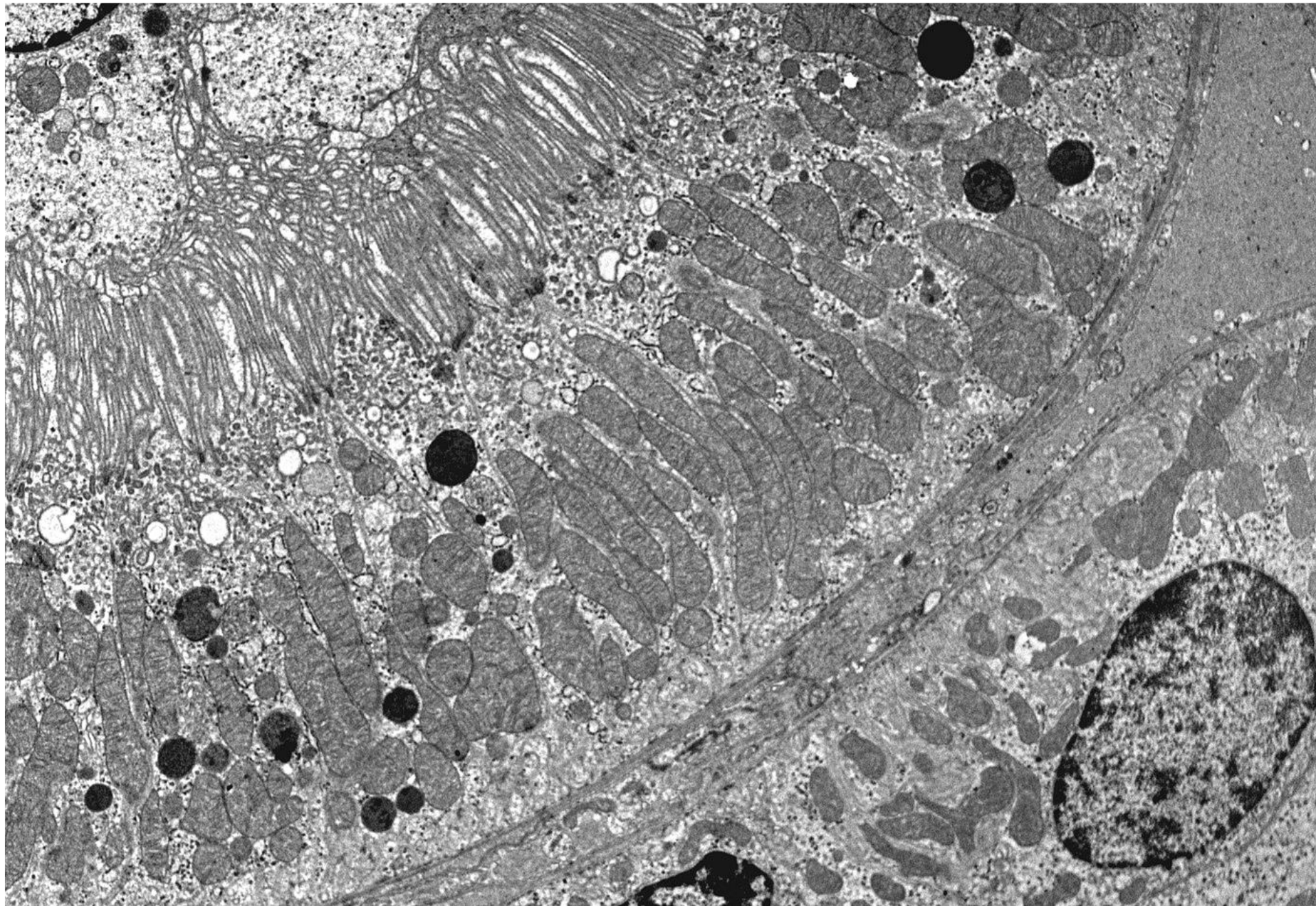


Simple cubic-columnar epithelium

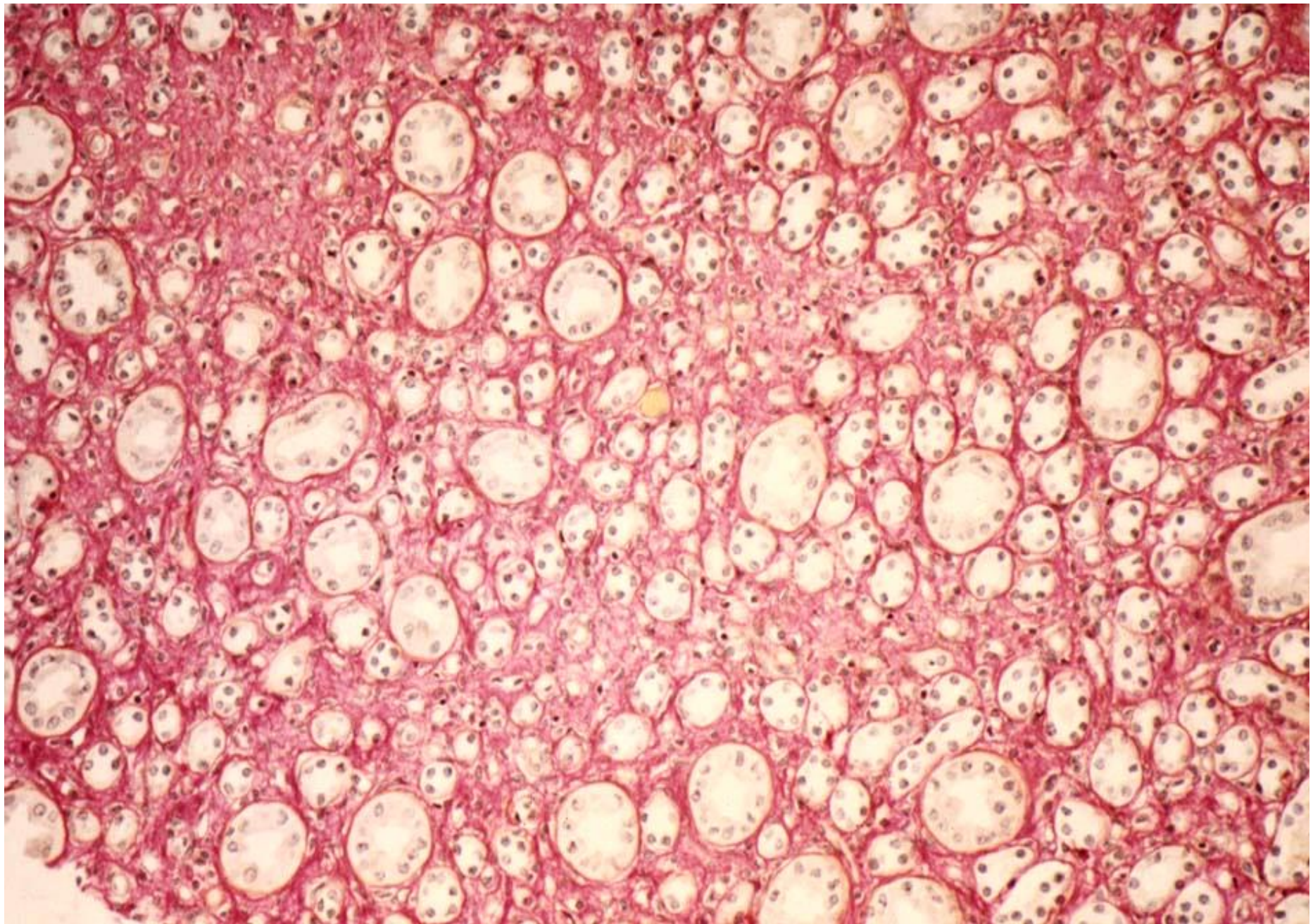
Ren – proximal tubule (ELM): brush border, basal labyrinth



Ren – proximal tubule (ELM): brush border, basal labyrinth



Ren (Weigert-van Gieson) - medulla



Ren (HE): medulla

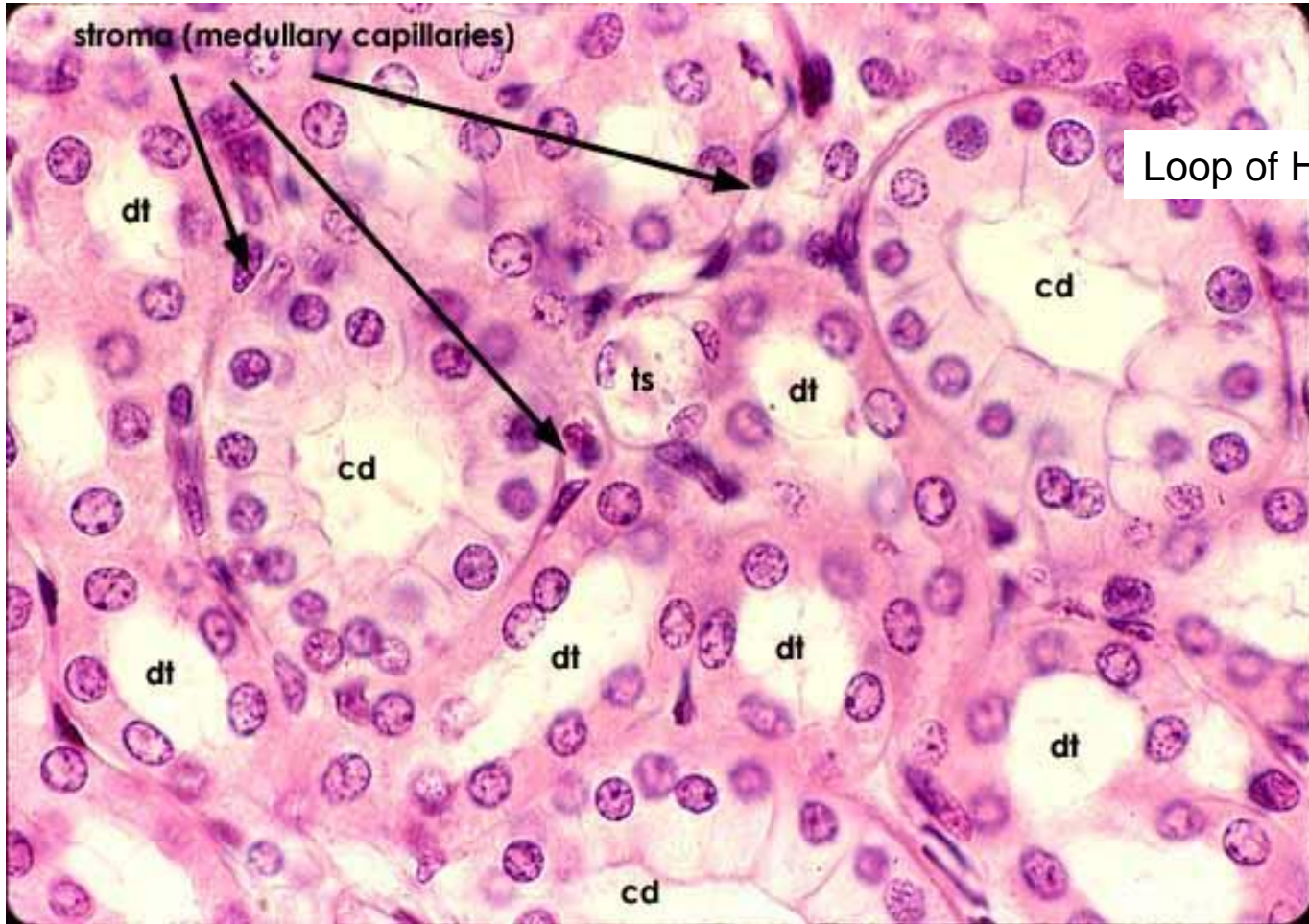
Loop of Henle – thin segment



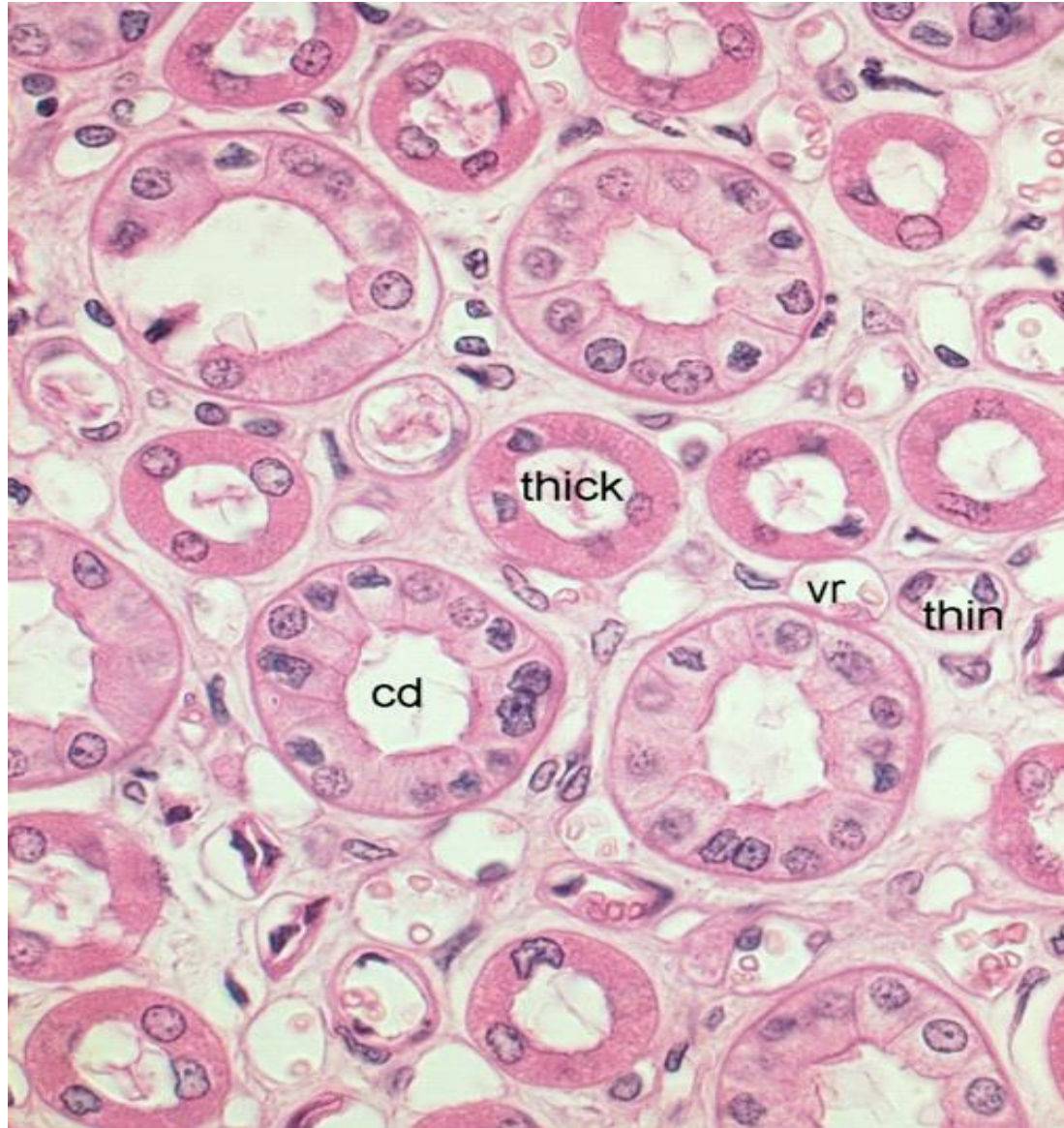
Loop of Henle – thick segment



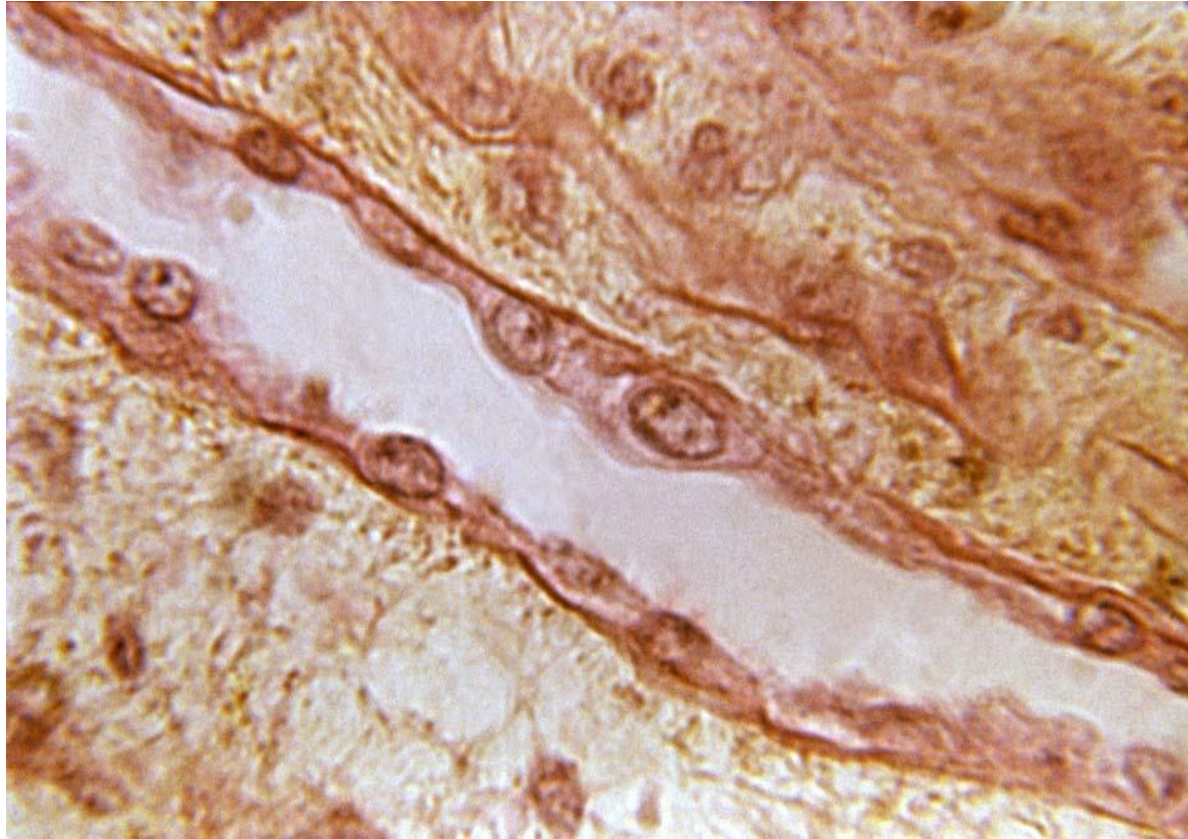
ductus colligens



Ren – medulla (HE)



Ren (HES) – medulla: thin segment of Loop of Henle (*longit.*)



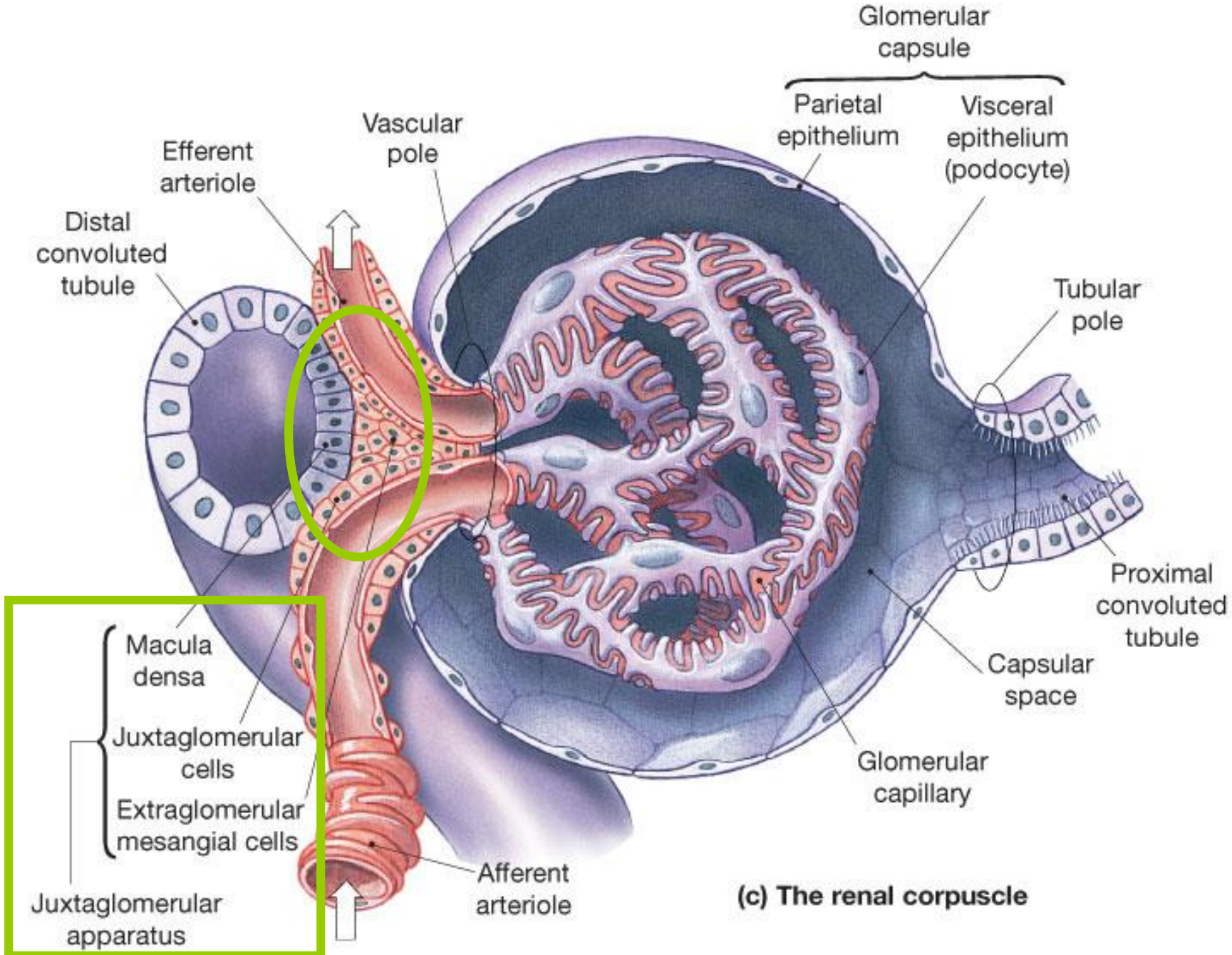
Juxtaglomerular apparatus

(renin & erythropoetin)

Endocrine kidney cells:

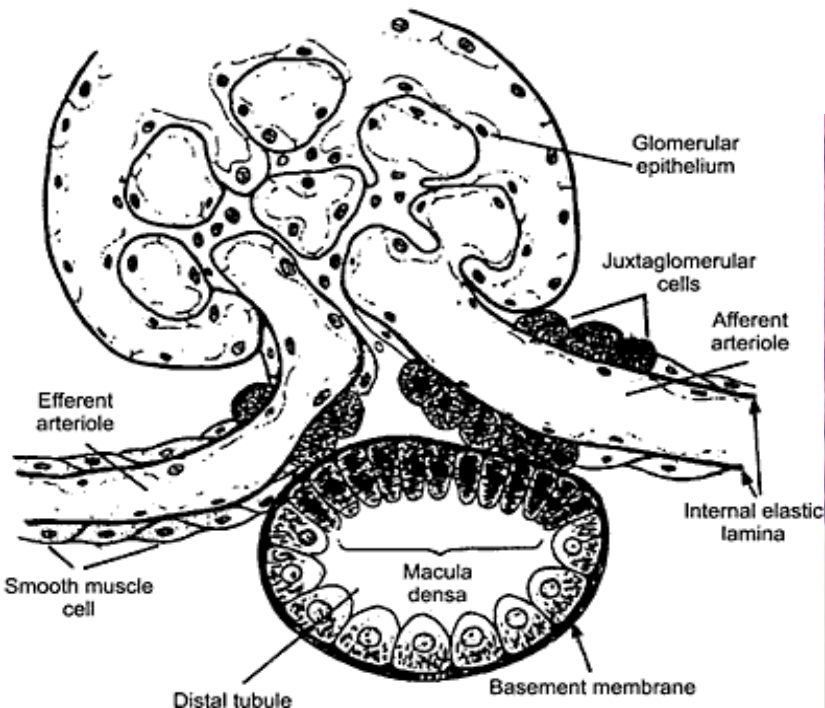
- **juxtaglomerular cells** (modified leiomyocytes of the wall of vas afferens)
- **macula densa** (cells of distal tubule)
- **mesangial cells** (extraglomerular mesangium – modified fibroblasts intercalated between capillaries in the vascular pole)

(intraglomerular mesangium – pathologic relevance – inflammation – collagen deposition)



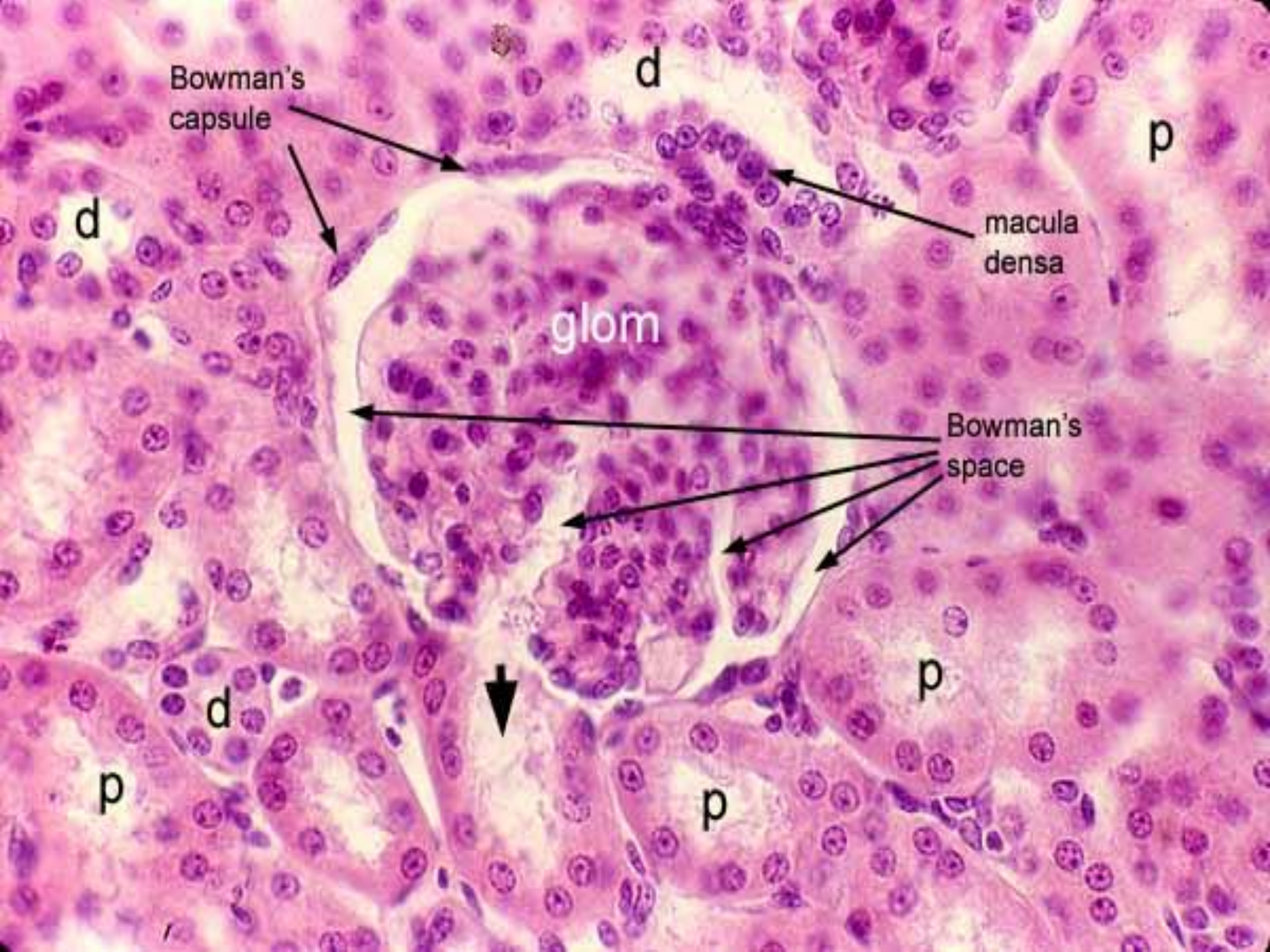
(c) The renal corpuscle

Juxtaglomerular apparatus



BC - Bowman's capsule (parietal layer) Pod - podocyte (visceral layer of Bowman's capsule)

MD - macula densa JG - juxtaglomerular cells DC - distal convoluted tubule



Bowman's capsule

d

p

d

macula densa

glom

Bowman's space

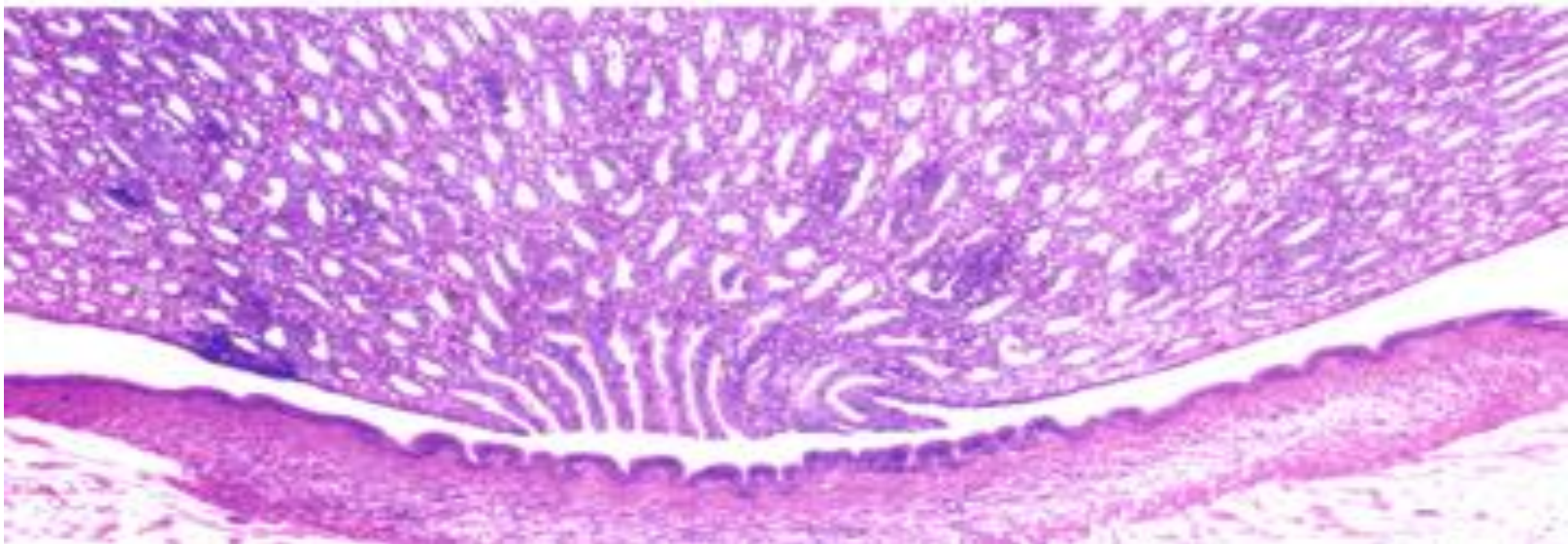
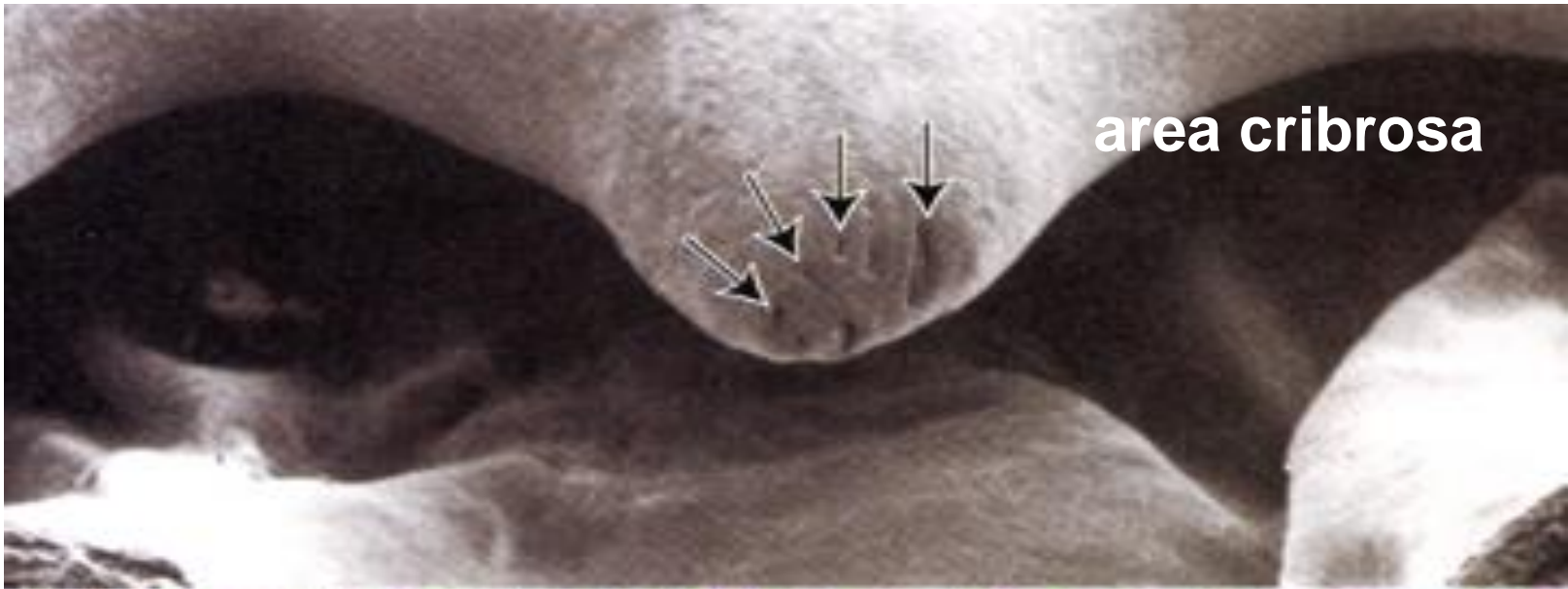
d

p

p

p

Papilla renalis





medulla

foramina papillaria

transitional
[urotel]

Area cribrosa on papilla renalis

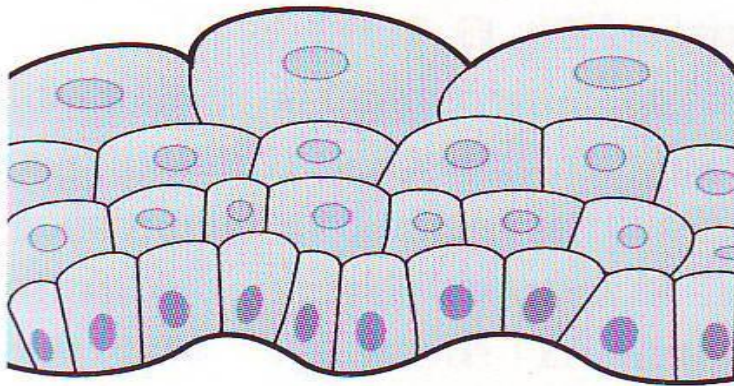
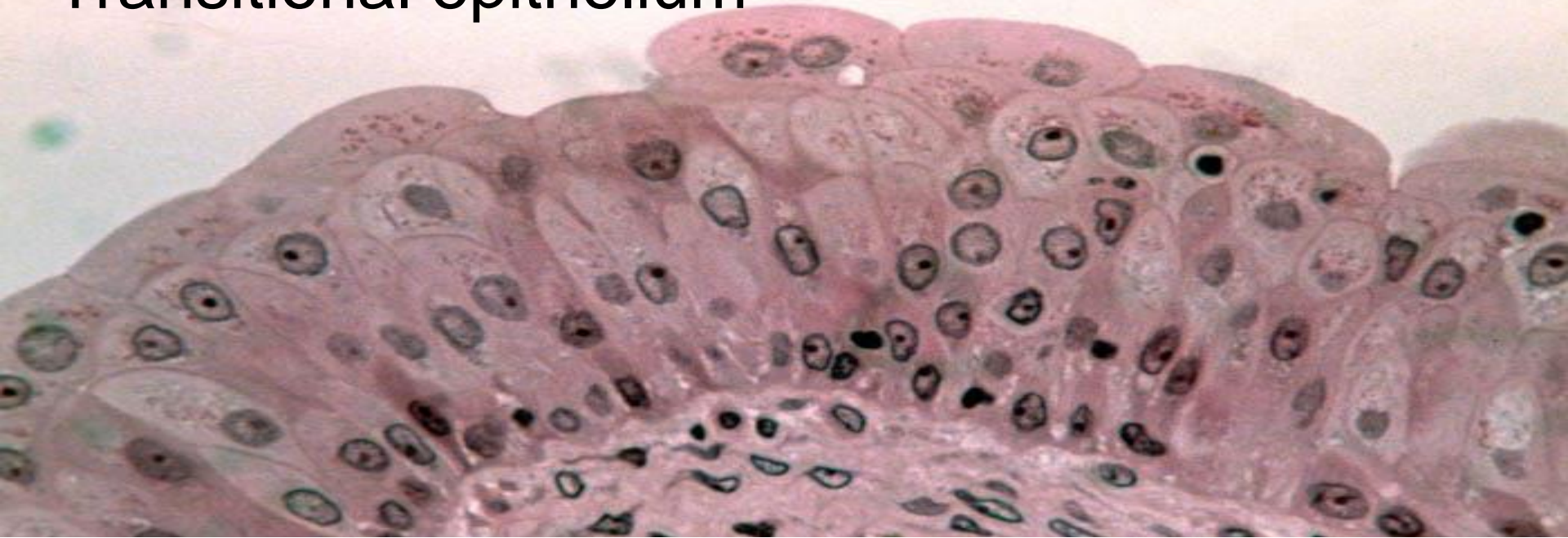
Excretory passages

- intrarenal:
 - tubuli colligentes
 - ductus colligentes
 - ductus papillares
- extrarenal:
 - calyces minores
 - calyces majores
 - pelvis renalis
 - ureter
 - vesica urinalis
 - urethra (feminina, masculina)

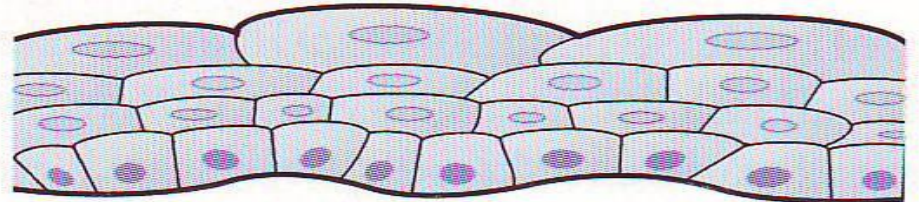
Extrarenal excretory passages

- **Mucosa** - epithelium, lamina propria mucosae
- **tunica muscularis** - smooth muscle tissue arranged into two concentric layers (or 3 – lower third of ureter, bladder)
- **adventitia** - (bladder – partially serosa)

Transitional epithelium

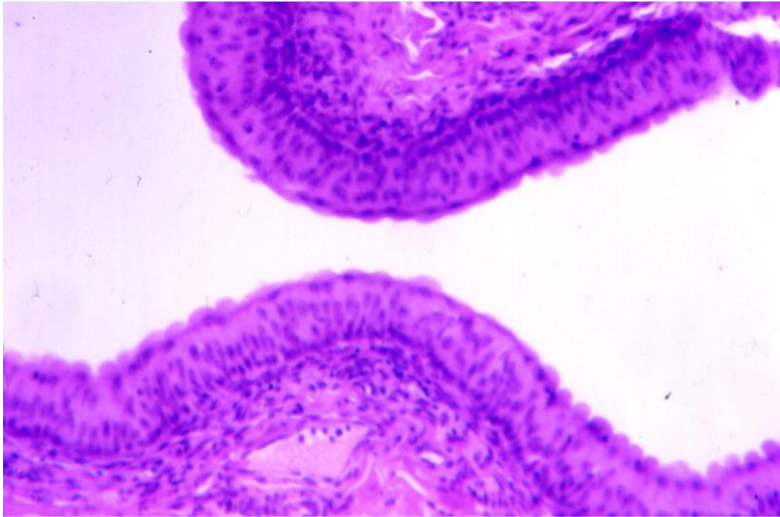


A Relaxed

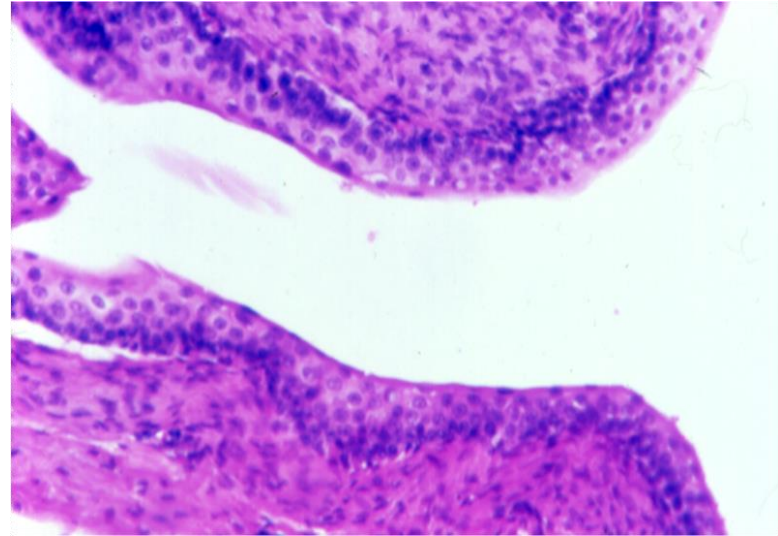


B Stretched

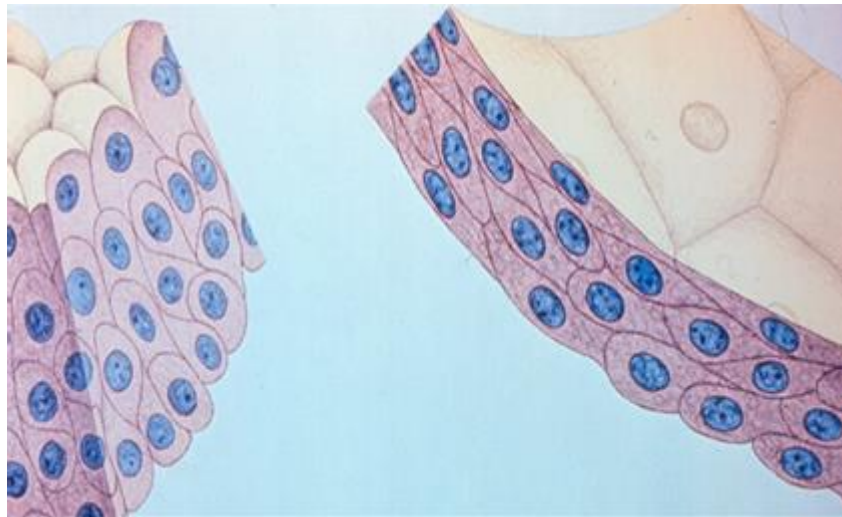
(calyces et pelvis renalis, ureter, vesica urinalis, pars muralis urethrae)

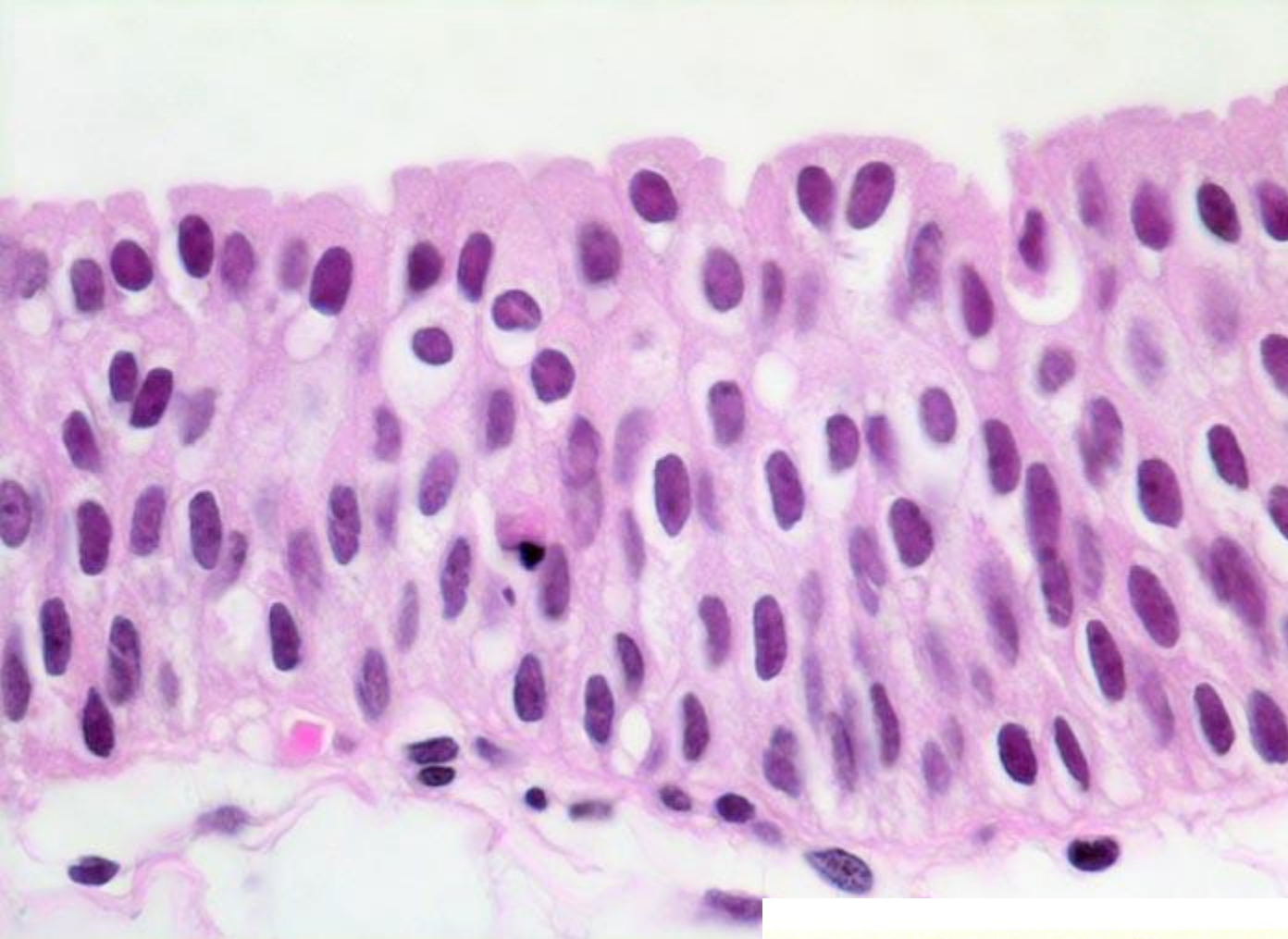


Empty
m. detrusor contracted



Full
m. detrusor relaxed

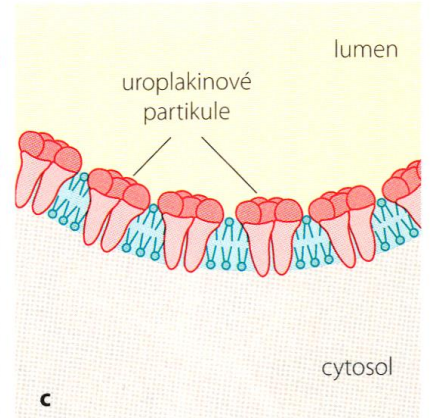
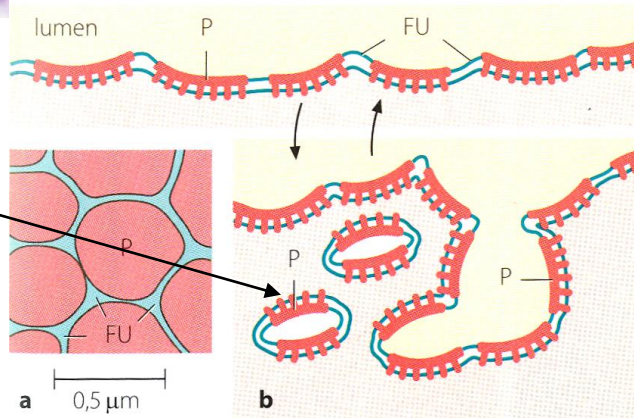
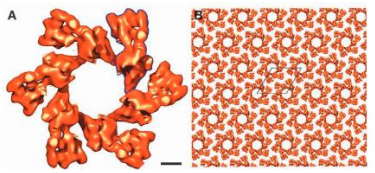




Adaptation to volume changes and osmotic resistance

Cell architecture
 Membrane flexibility
 Rigid layer of uroplakin

Uroplakin



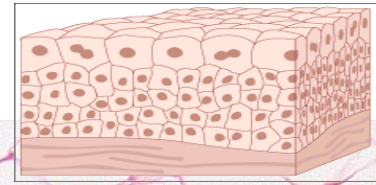
Calyx renalis (HE)



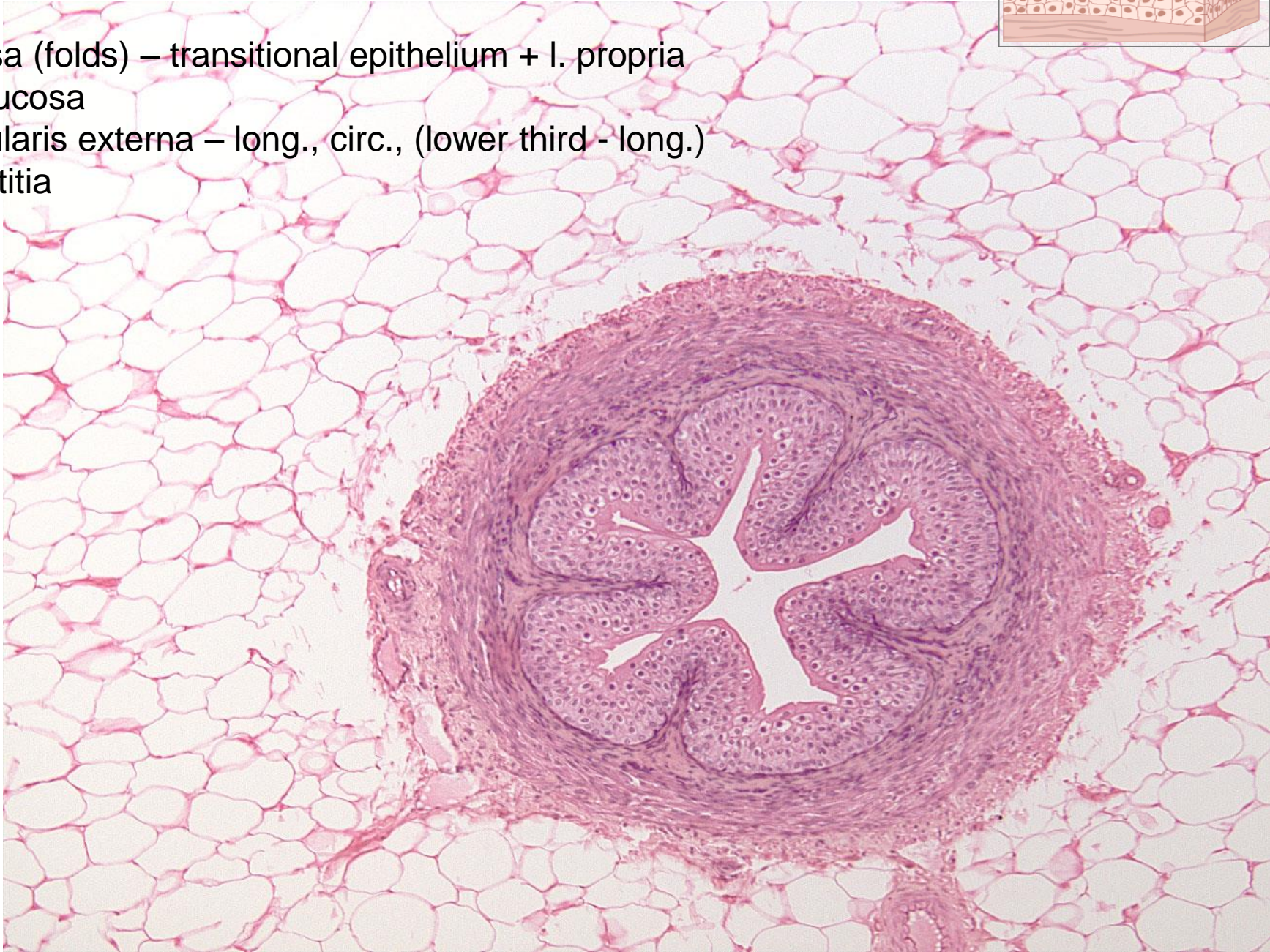
artery

20 μm

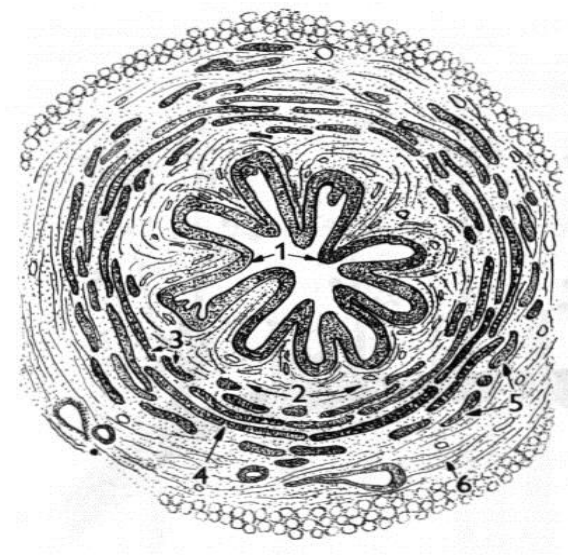
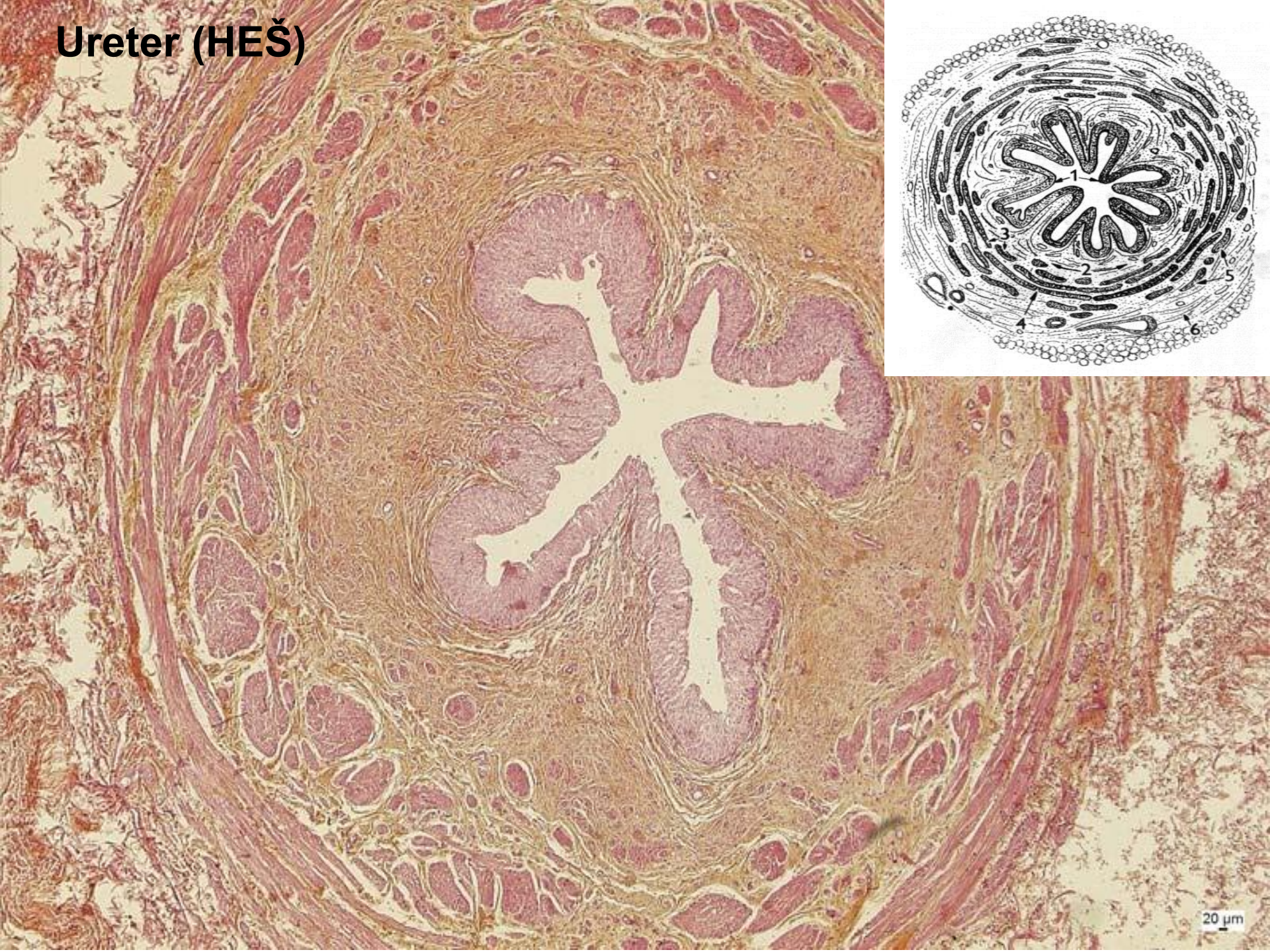
Ureter:



- Mucosa (folds) – transitional epithelium + l. propria
- Submucosa
- Muscularis externa – long., circ., (lower third - long.)
- Adventitia

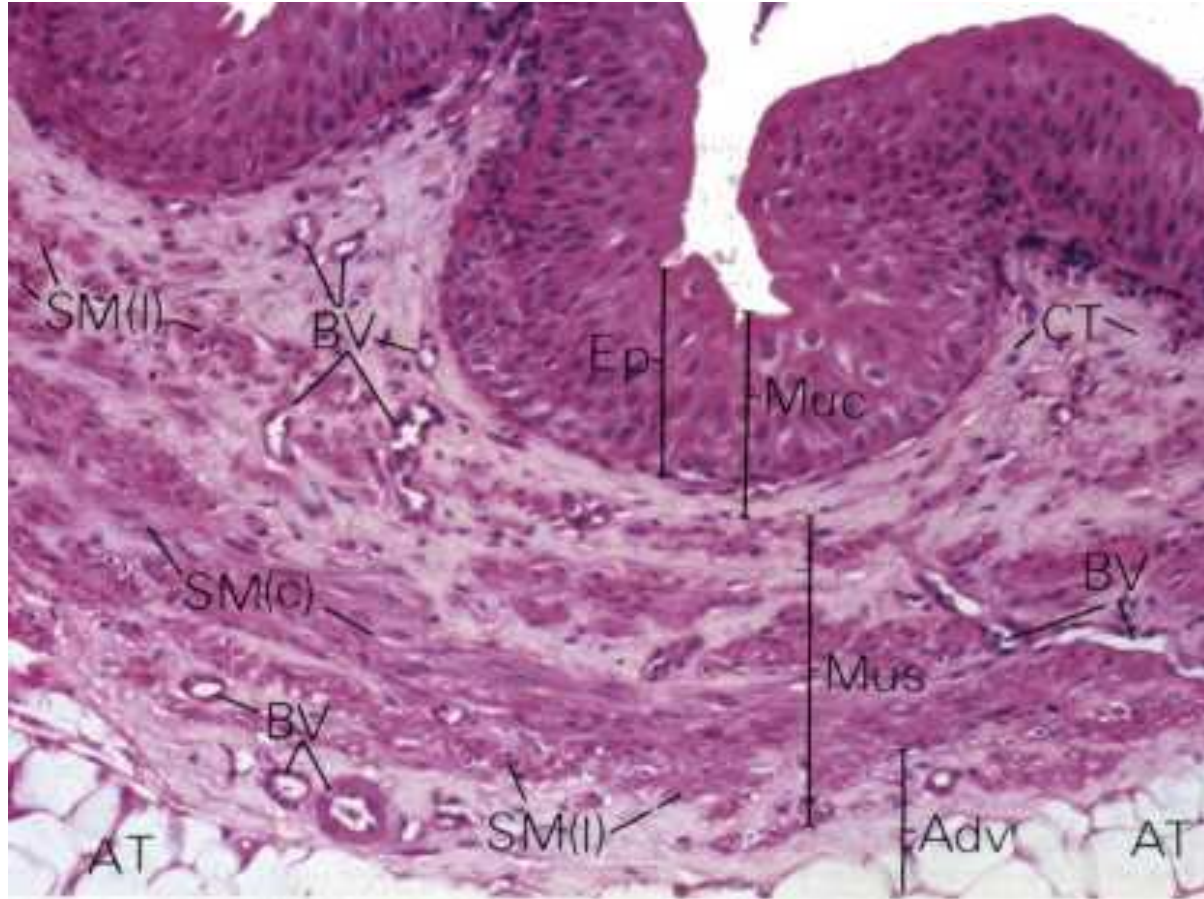


Ureter (HEŠ)

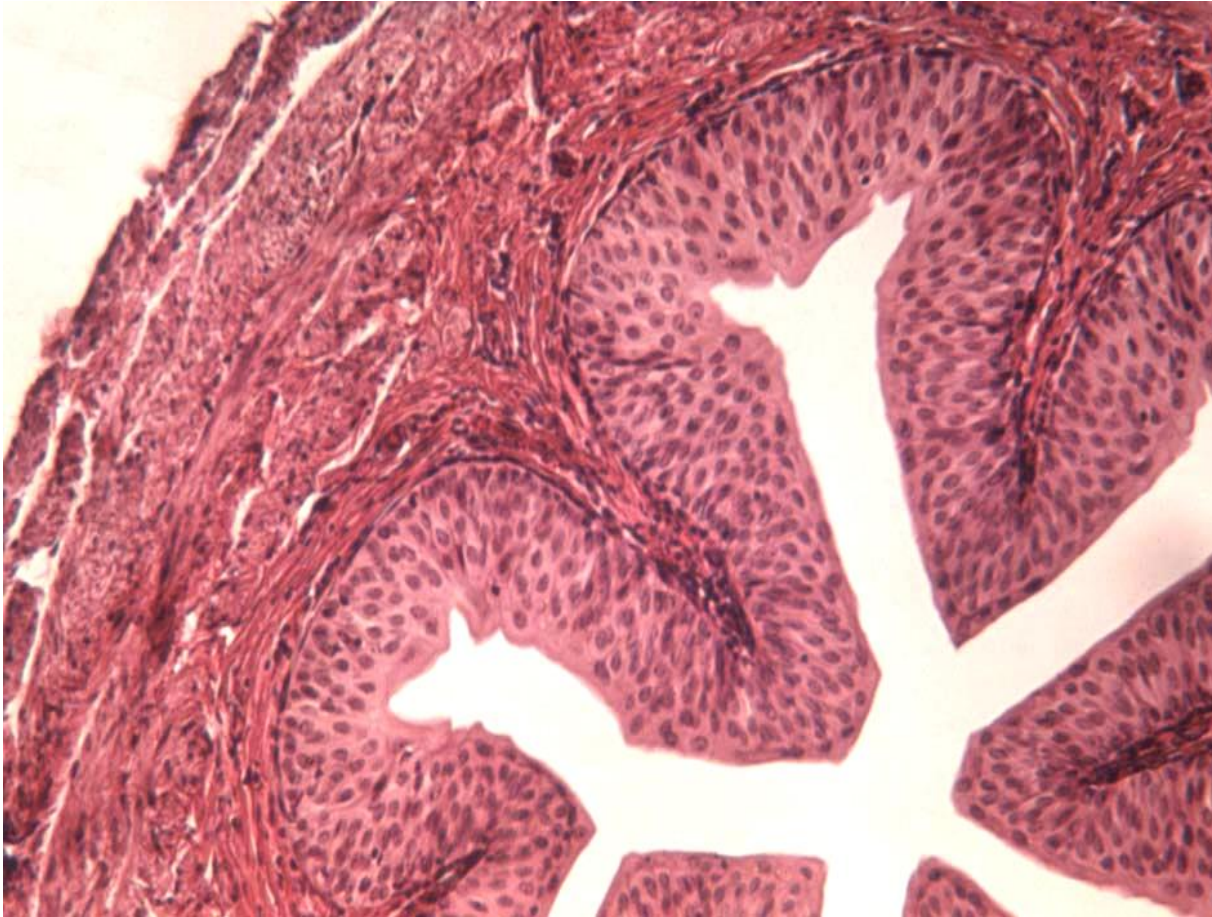


20 μm

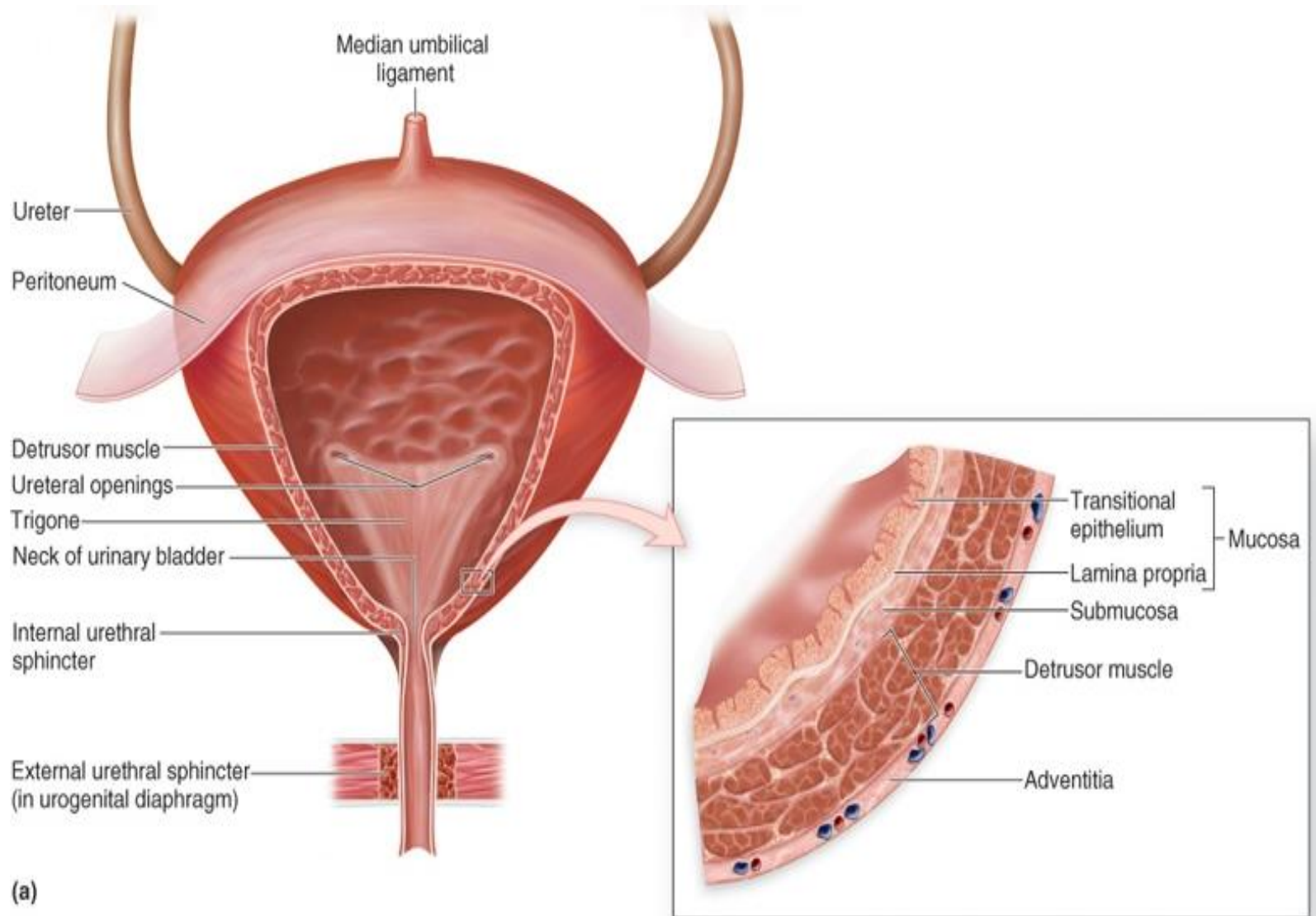
Ureter (HE)



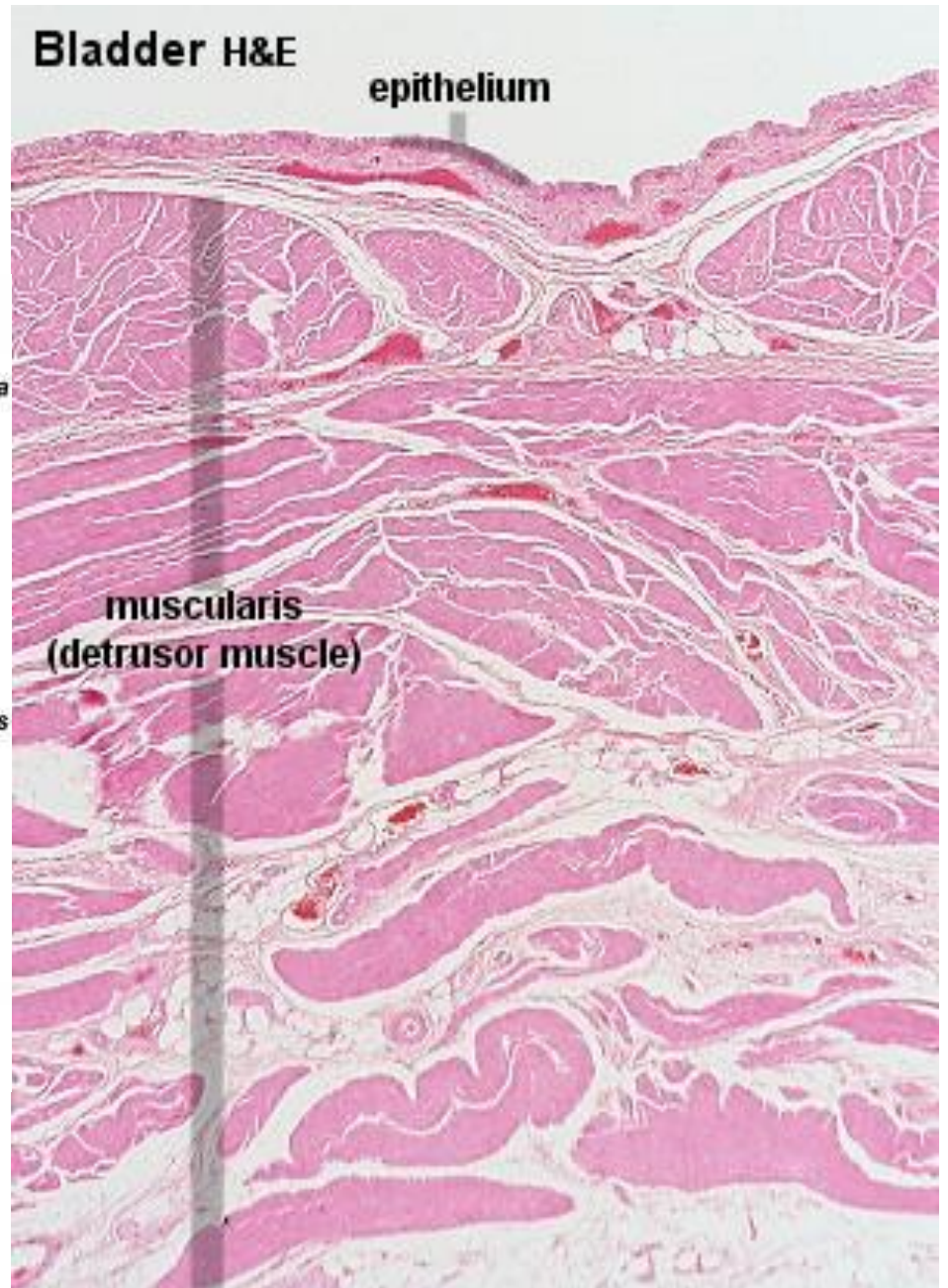
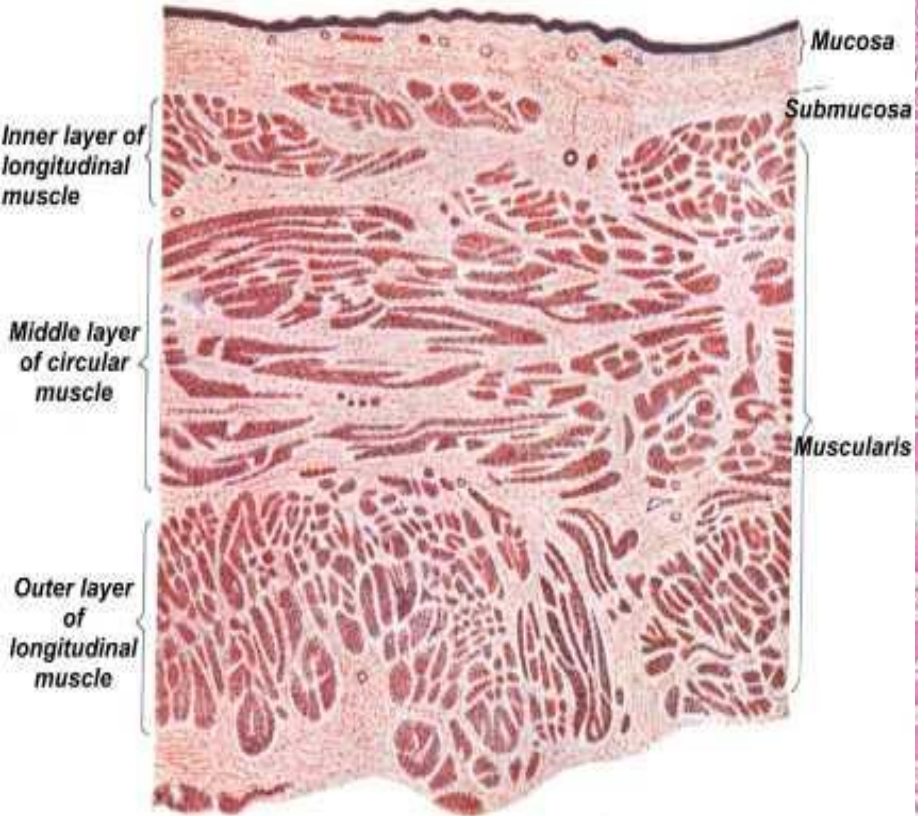
Ureter (HE)



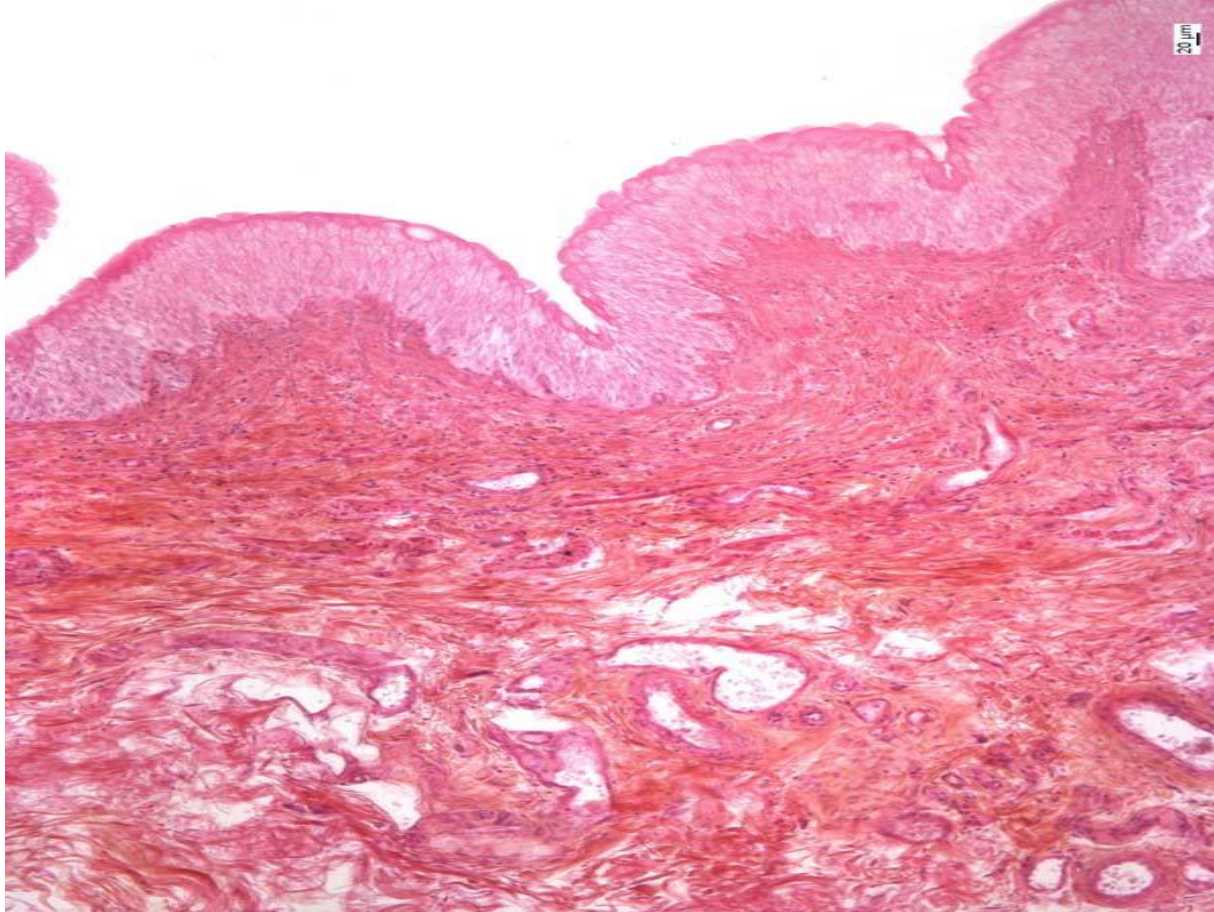
Vesica urinalis



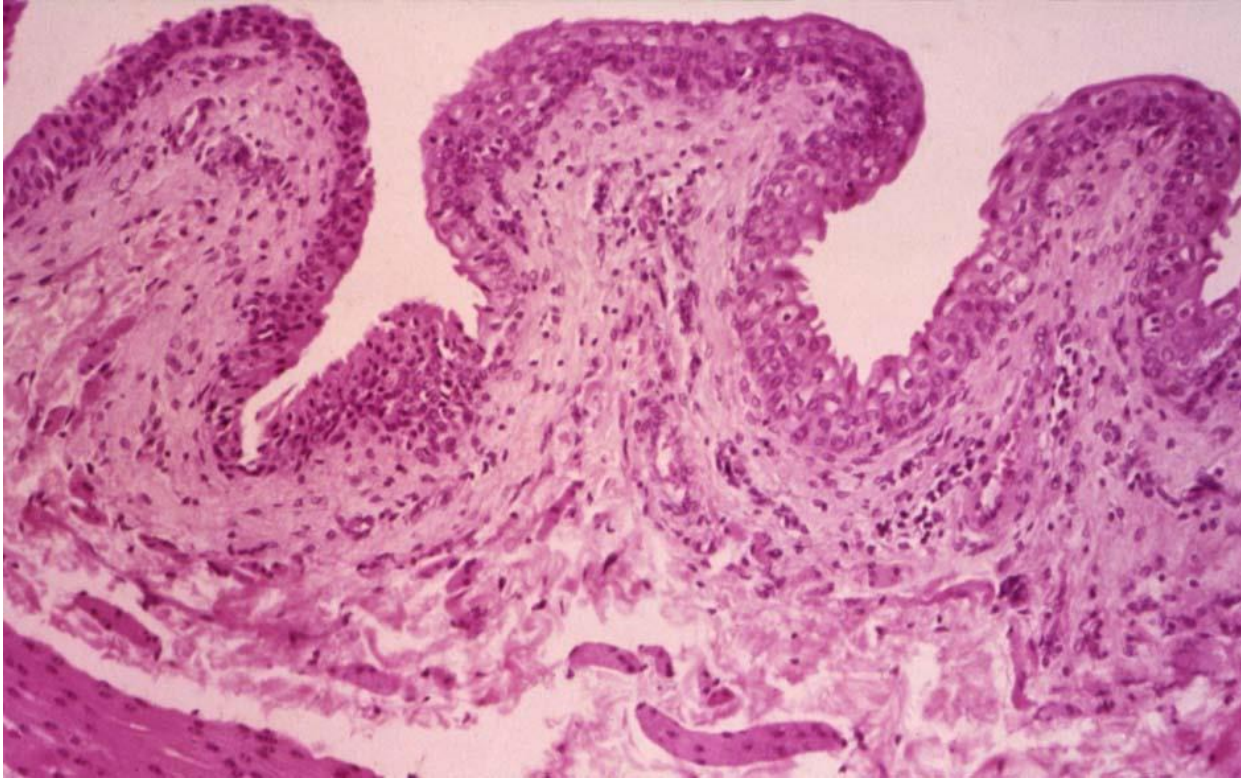
Vesica urinalis



Vesica urinalis (HE)

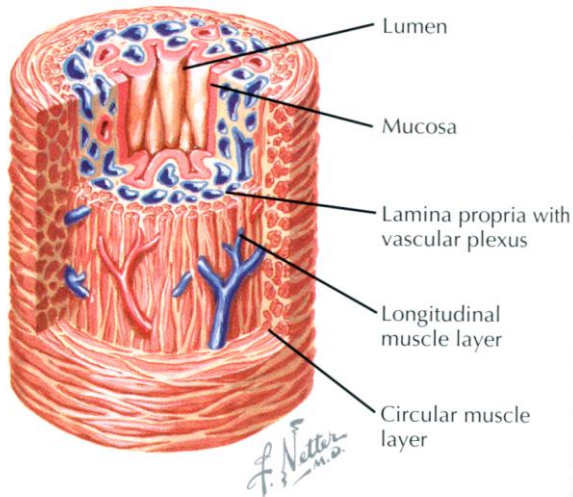


Vesica urinalis (HE)



Urethra feminina

▼ Female Urethra.

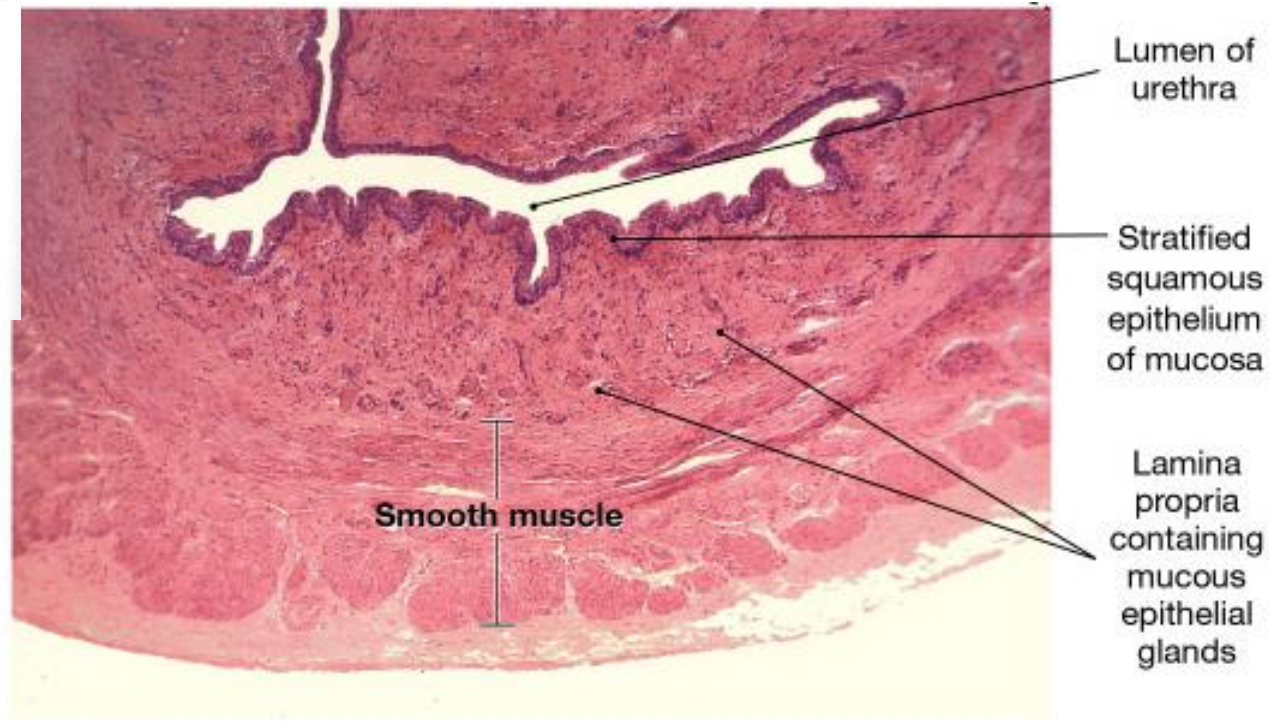


Mucosal folds

Stratified squamous epithelium

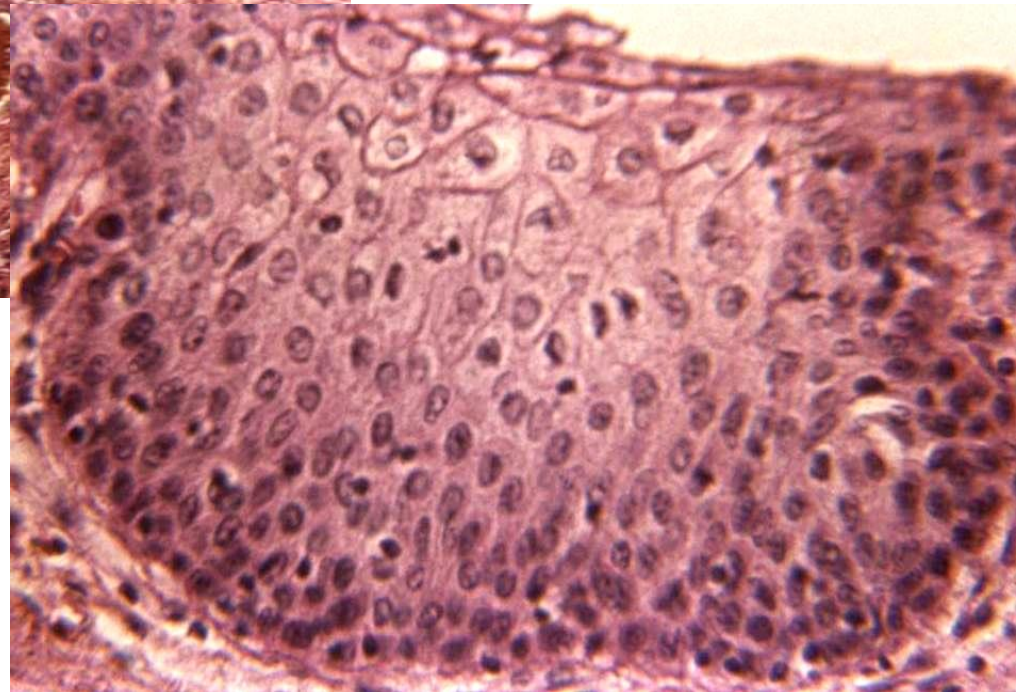
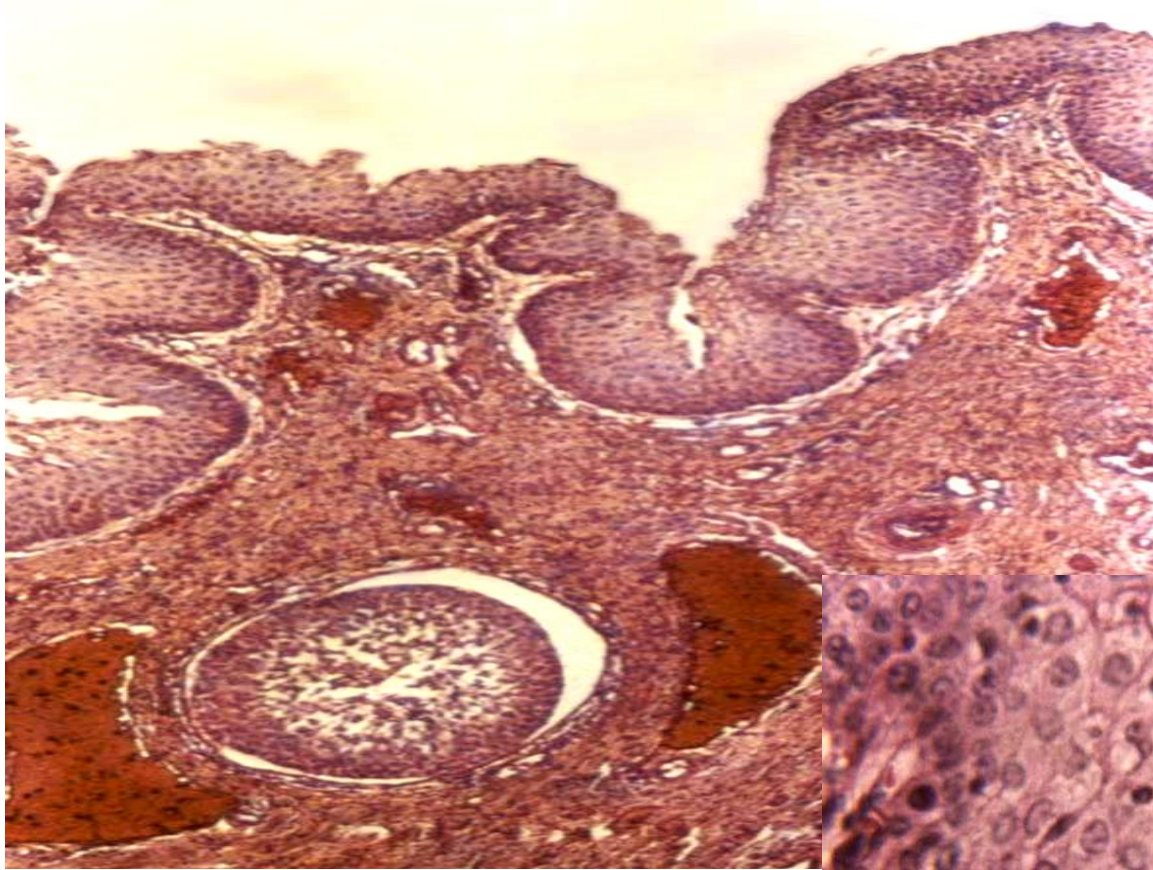
Lacunae urethrales

Paraurethral glands



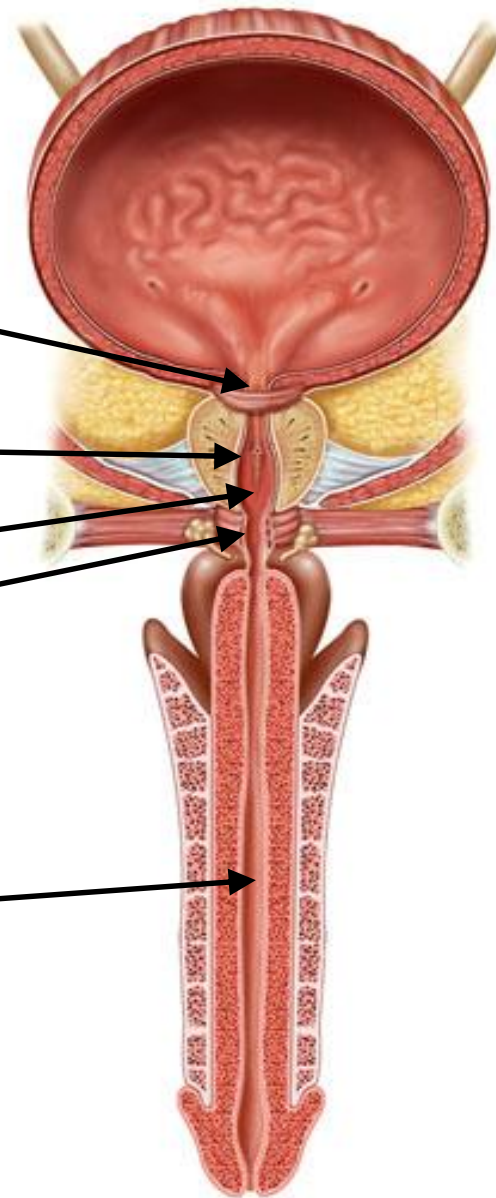
(c) Female urethra (LM × 61)

Urethra feminina (HE)



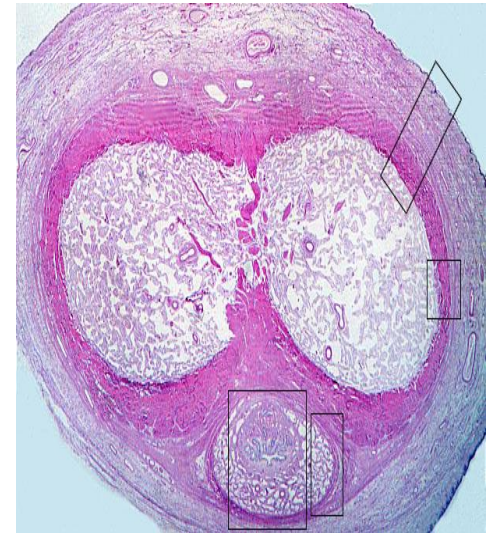
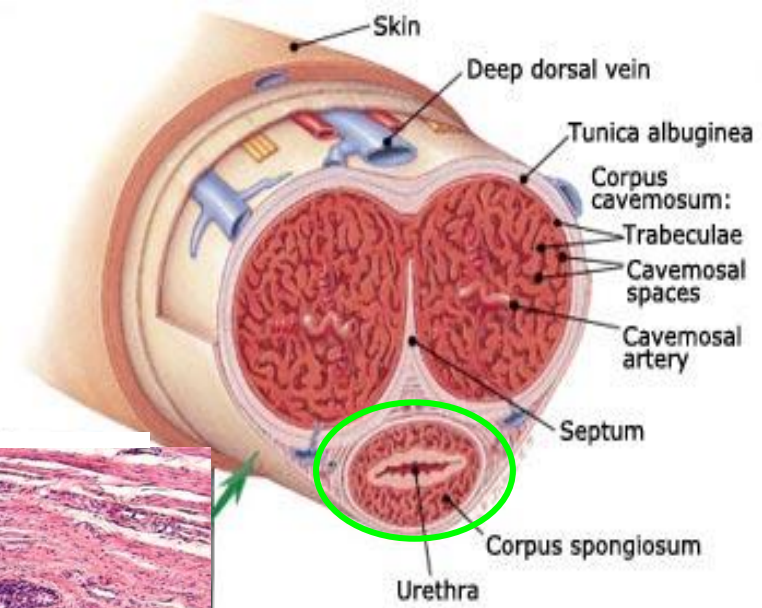
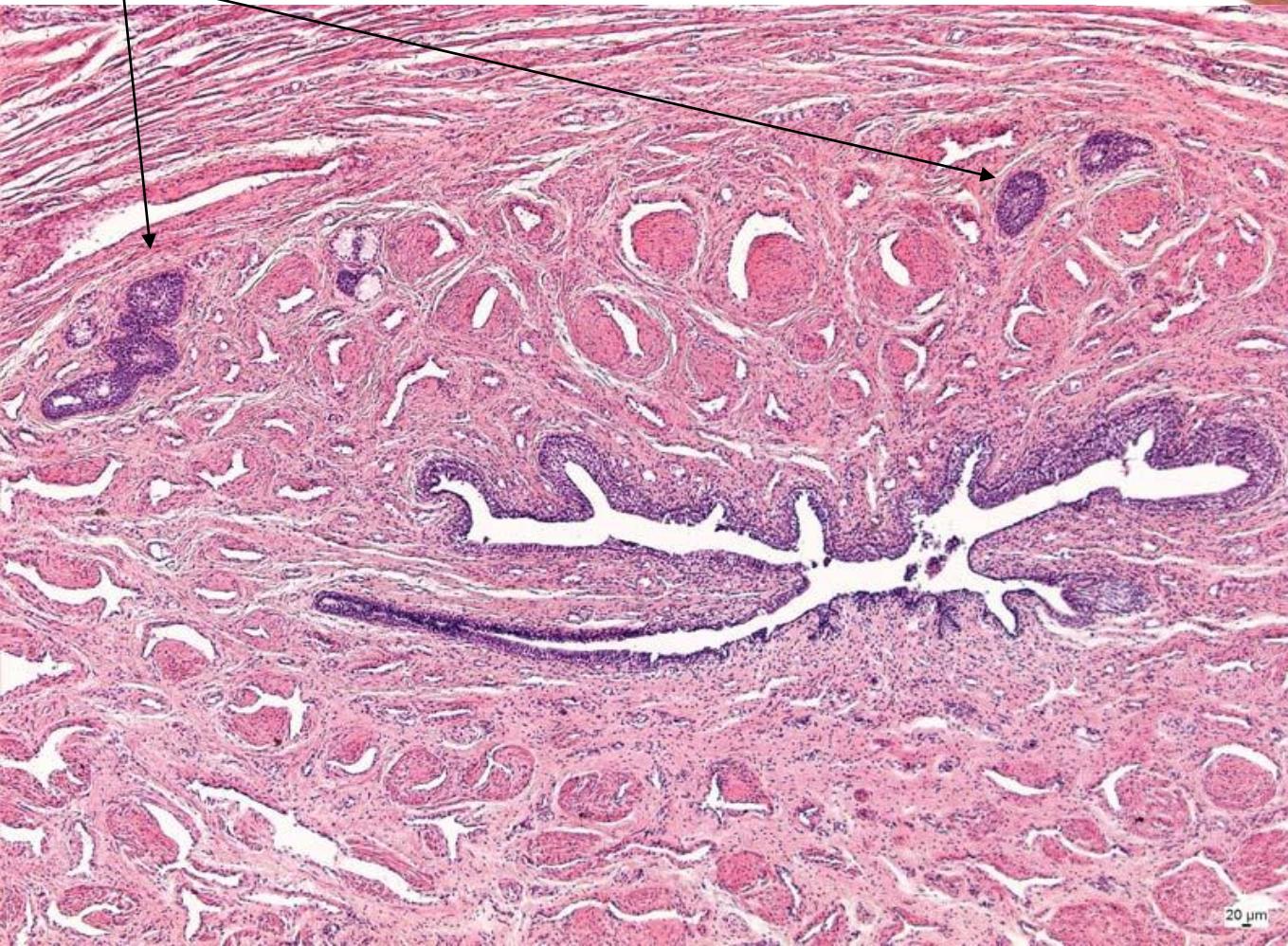
Urethra masculina

- **Pars intramuralis**
 - *transitional ep.*
- **Pars prostatica**
 - *transitional ep.*
- **od colliculus seminalis:**
 - *pseudostratified columnar ep.*
- **Pars diaphragmatica**
 - *stratified columnar ep.*
 - *Tunica musc: m. sphincter urethrae ext.*
- **Pars cavernosa**
 - *stratified columnar ep.*
- **fossa navicularis:**
 - *Stratified squamous*
 - *Lacunae urethrales Morgagni*



Urethra masculina – pars spongiosa

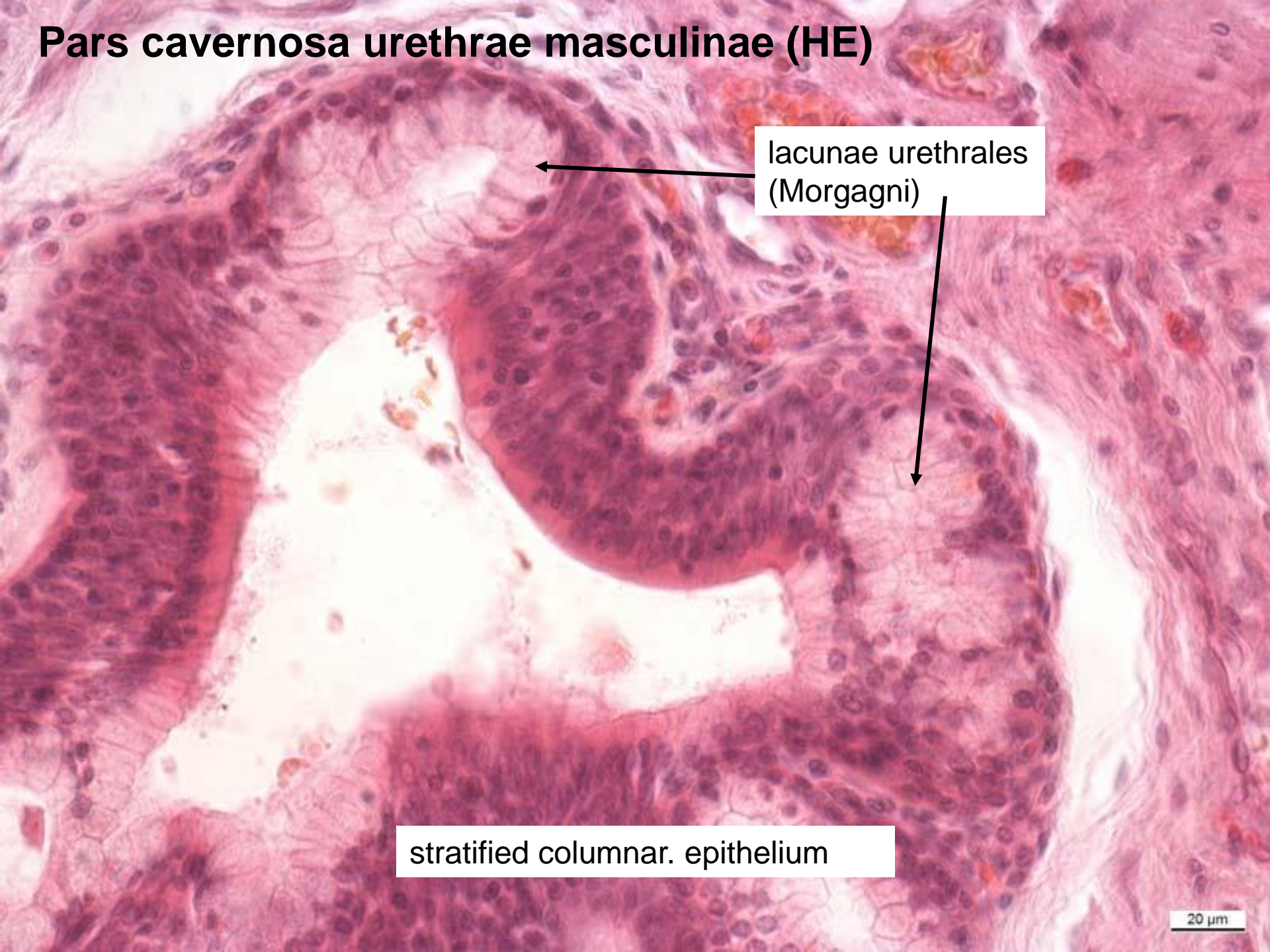
Gll. paraurethrales (Littre)



Pars cavernosa urethrae masculinae (HE)

lacunae urethrales
(Morgagni)

stratified columnar. epithelium



4. Urinary system

Slides:

- 30. Ren(HE)
- 31. Ren (Weigert-van Gieson)
- 32. Calyx renalis(HE)
- 33. Ureter(HE)
- 34. Vesica urinalis (HE)
- 35. Urethra feminina(HE)
- 41. Penis – urethra masculina (HE)

Atlas EM:

- basal labyrinth (49)
- filtration membrane (41)