

Posterior abdominal wall

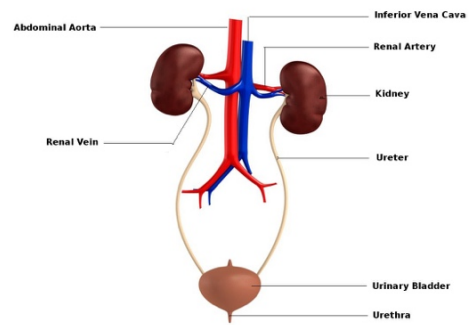
- ① Psoas major
- ② Psoas minor
- ③ Quadratus lumborum
- ④ Iliacus

URINARY SYSTEM

Its function is **production of urine**.

Urinary system consists of **organs of urine production**, which are

- **kidneys**, and
- **urinary tract** that consist of:
 - Ureters
 - Urinary bladder
 - Urethra



Kidneys:

They are paired organs that are **located in the abdominal cavity** and are **retroperitoneal organs** (not covered but located behind the peritoneum). **Right kidney is located more inferior to the left kidney because of the liver.**

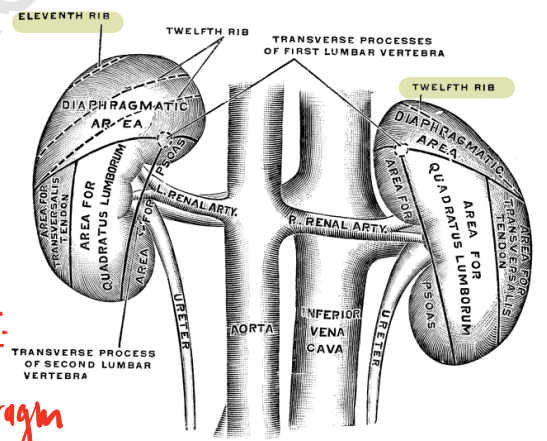
Topography of right and left kidney:

- right kidney is between **T12 and L4**, and *lower*
- left kidney is located between **T11 and L3**. *one vertebrae above*

So, the left kidney is slightly higher than the right kidney.

Kidneys have:

- anterior and posterior surfaces,
 - medial and lateral margins, and
 - superior and inferior ends.
- left kidney contacts:*
 - ventriculus
 - spleen
 - diaphragm



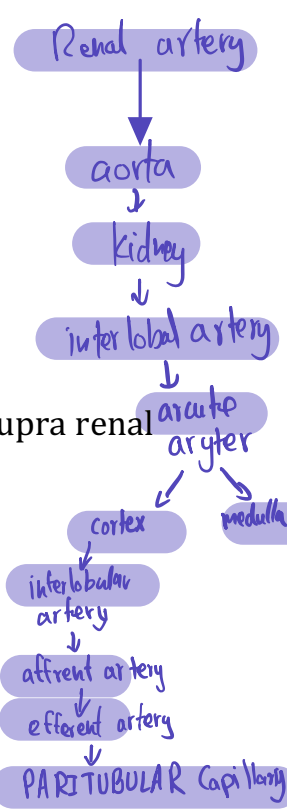
On the medial margin, it has **depression**, which is called **renal hilus**.

Structure of renal hilus: from anterior to posterior we have:

- **renal vein** (which leaves kidney and enter the inferior vena cava),
- **renal artery** (which is branch of abdominal aorta and enters the kidney),
- **renal pelvis** (which leaves the kidneys and becomes into ureters), and
- **lymphatic vessels**.

On the superior end of kidneys are **adrenal glands** (that is why they are called supra renal glands).

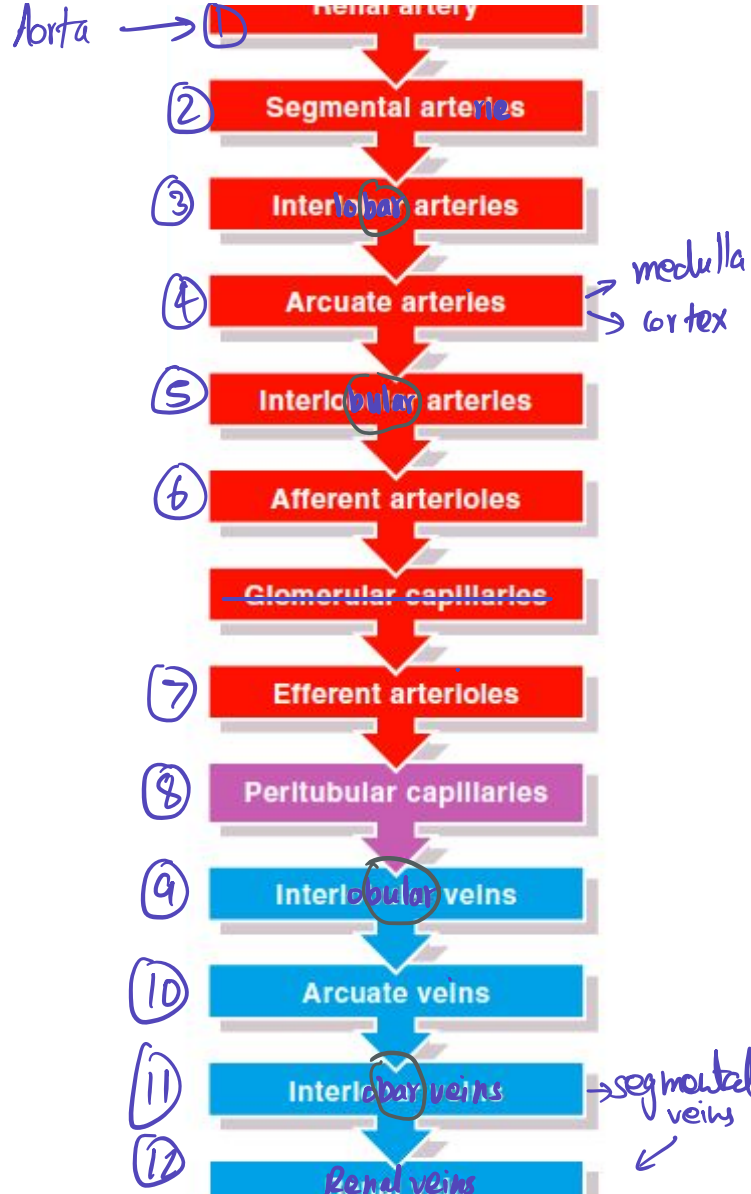
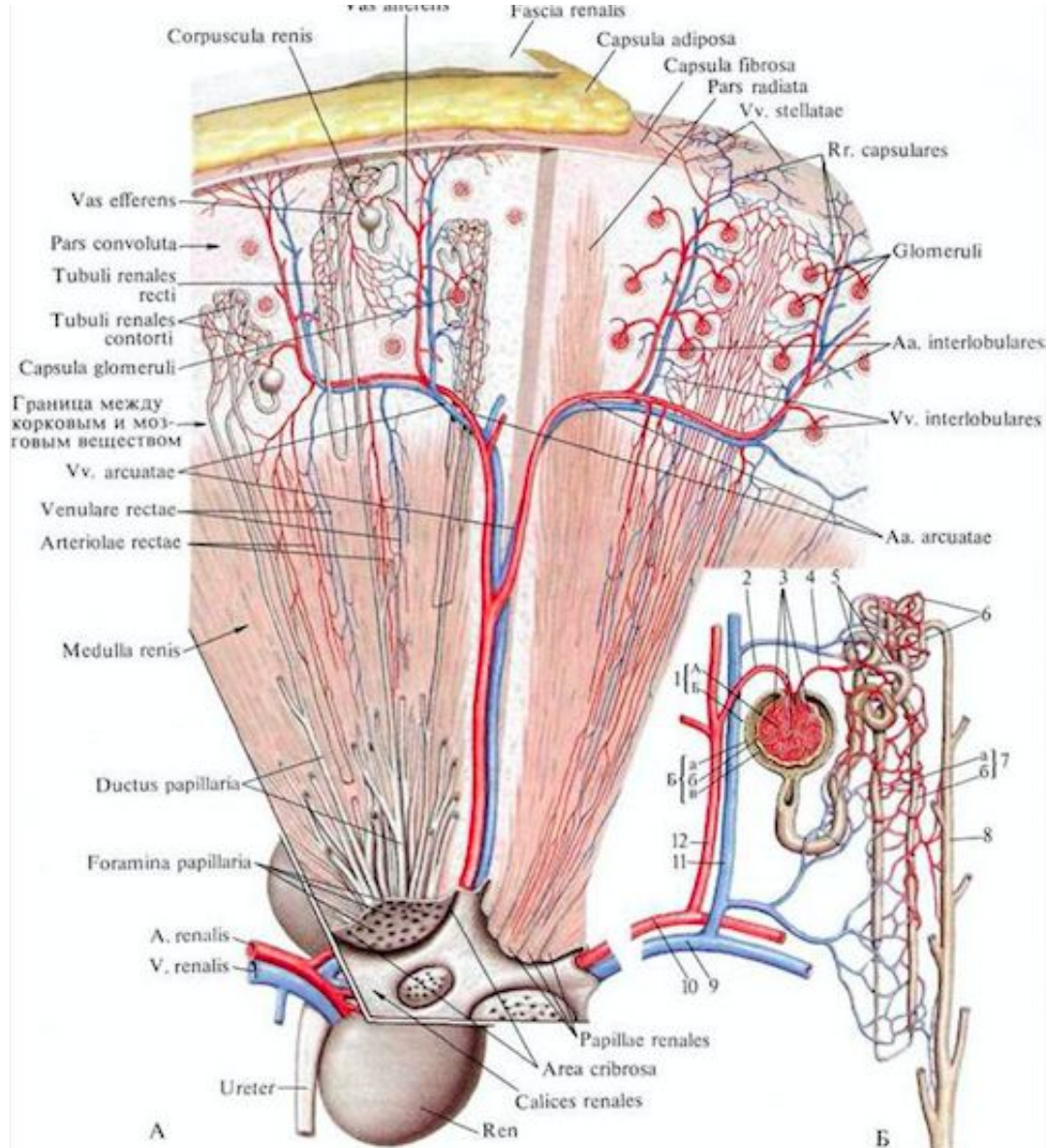
Their name directly relates to their location (ad—near or at; renes—kidneys).



Fixation

- right - hepatorenal lig. - between liver and kidney
- left - lienorenal lig. - between spleen and kidney

left renal vein - longer



Coverings of kidney:

- fibrous capsule: covers loosely*
- adipose capsule: shock absorber*
- renal fascia: anterior: covers both kidneys; posterior: covers one attached to vertebrae and attach other one also.*

Kidneys are covered by **renal fascia**, which is formed by **retroperitoneal fascia** (peritoneum stands **anterior** to the kidneys and does not cover kidneys). Renal fascia consists of:

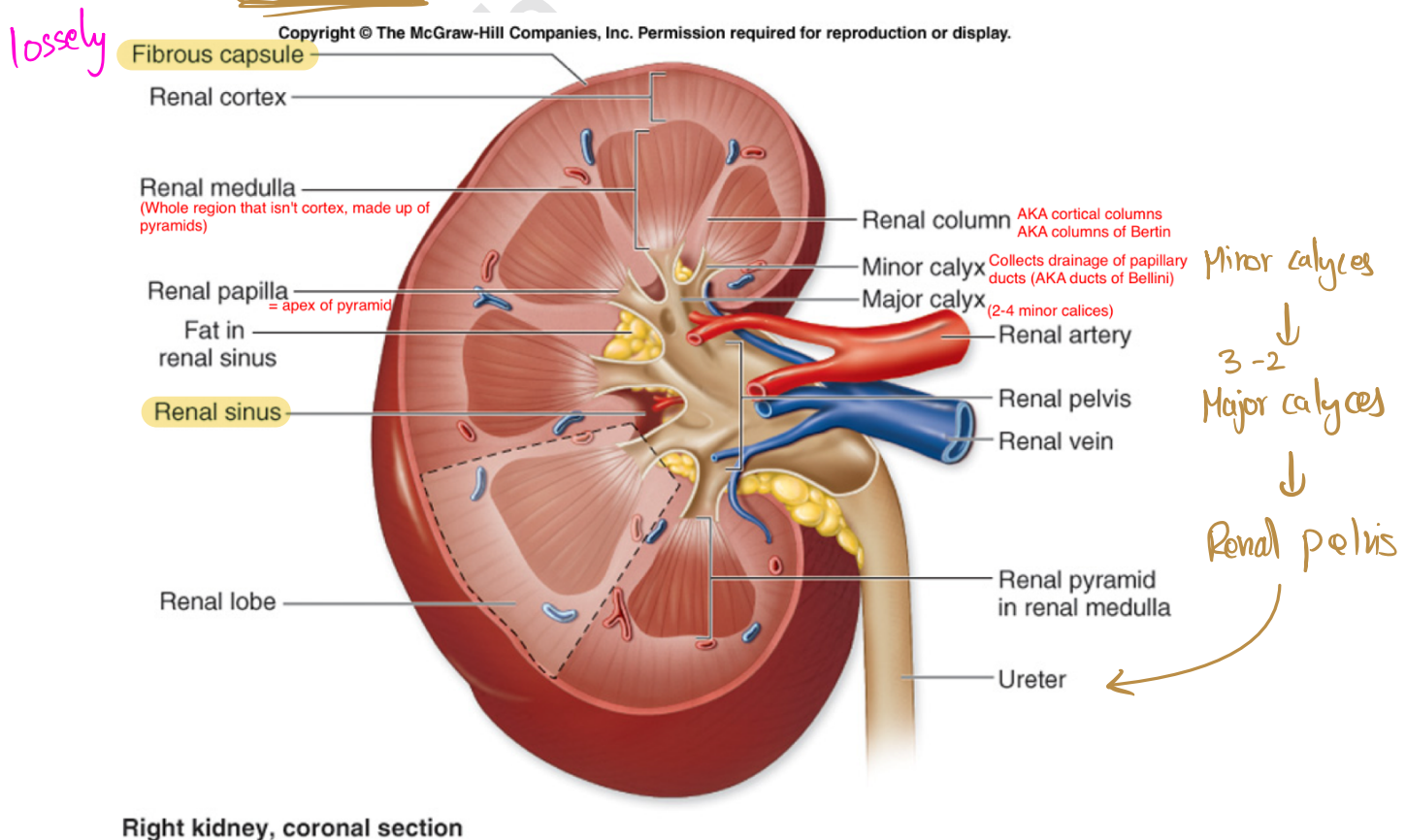
- **anterior lamina**, which covers both right and left kidneys, and
- **posterior lamina**, which is separated for right and left kidneys and is attached to vertebrae.

Under renal fascia is **adipose capsule** (fatty capsule), which **protects** kidneys. Under adipose/fatty capsule is **fibrous capsule**, which directly **covers** parenchymal kidney. *shock absorber* *covers loosely*

Parts of the Kidneys: kidneys consist of 2 main parts:

- **Renal sinus:** consist of approximately **11 minor calyces**, they unite to form **2 to 3 major calyces** that unite to form **renal pelvis**, which leaves the kidneys and becomes into **ureter**. *top part cribriform area* *urinary bladder → releases urine!!*
- **Renal parenchyma:** consists of **renal cortex** and **renal medulla**. Medulla makes **pyramids**. Base of pyramid faces to the renal cortex, and the apex of pyramid faces to the renal sinus. *triangular* *cribriform area - small capillary holes*

On the apex of the pyramid, we have **renal papillary foramina** that makes **area cribrosa**. Renal cortex forms the **peripheral part** of the kidneys, and **renal cortex** enters within the **pyramids** to form **renal columns** or **cortical columns (Bertin columns)** between pyramids.



Functional Unit

Nephron

Corpuscular component

- Bowman's capsule
- Glomerulus

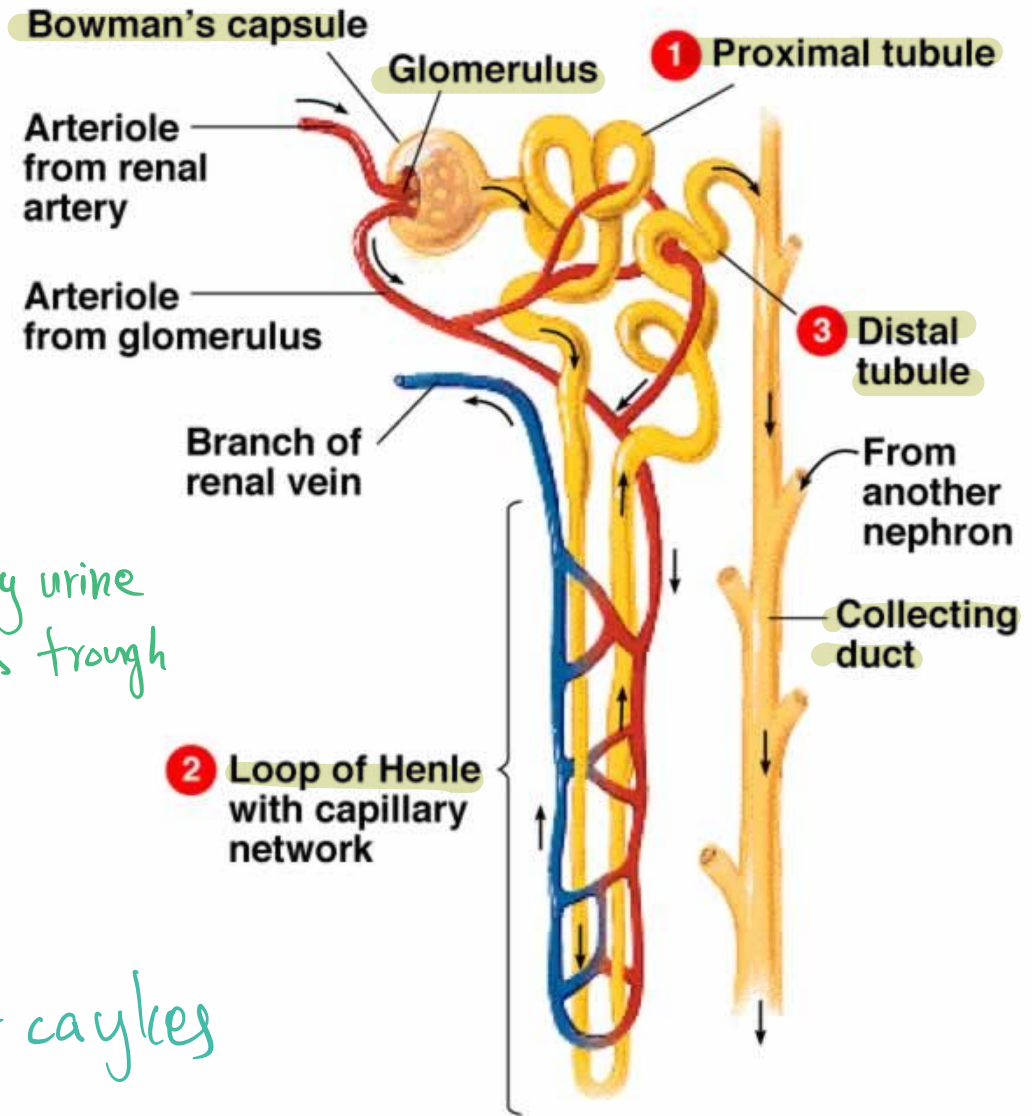
Tubular component

- Proximal convoluted
- Loop of Henle
- Distal convoluted
- Collecting ducts
- Papillary ducts

primary urine goes through

opens into cribriform area on top of pyramid

faces to the minor calyces



1 million

Structural and functional units of kidneys are **nephrons** which consists of:

- renal **corpus part**, and
- renal **tubular part**.

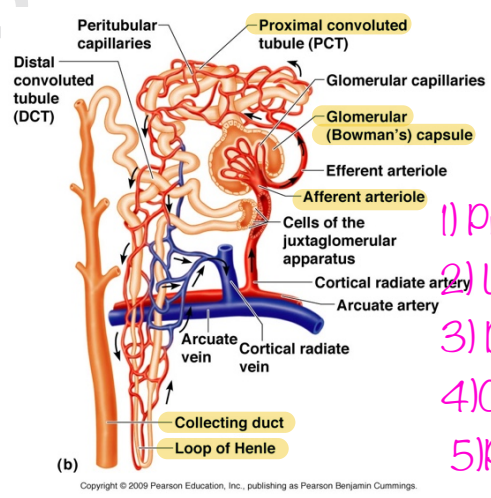
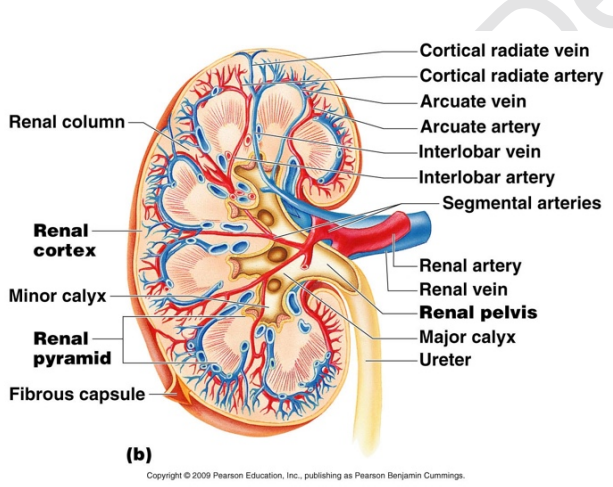
Formation of nephrons:

renal artery enters the **renal hilus** and branches into **anterior and posterior arteries**. They **gives of interlobar artery**, because each pyramid with surrounding cortex forms lobe of the kidney, and interlobar means between the lobes, and **interlobar artery goes within or between the pyramids**.

Interlobar artery **gives of arcuate artery** which goes **along the base of the pyramid**, and it **gives of arteriae rectae** (straight arterioles) for supplying blood to pyramids, and gives of **interlobular artery for cortex**.

Interlobular arteries give of **afferent arteriole**. afferent arteriole convolutes to form **glomerulus** which is covered by **Bowman's capsule**, and then leaves glomerulus at **efferent arterioles**.
↳ mainly in cortex

These structures, afferent arterioles, glomerulus, efferent arterioles and capsule form **renal corpuscle**, which is the portion of nephron.



- 1) Proximal convoluted
- 2) Loop of Henle
- 3) Distal Convoluted
- 4) Collecting ducts
- 5) Papillary ducts

Filtration of blood occurs in **renal corpuscle**, and **primary urine** is produced. primary urine is approximately 60 to 100 liters per day. Primary urine goes to **tubular part**.

Tubular part consists of

- **proximal convoluted tubules**,
- **distal convoluted tubules**, and
- **loop of Henle** which consists of descending and ascending parts.

but normally blood vessels: enters artery
Afferent arteriole - enters gives mesh primary urine is produced.
but here artery leaves vein
Efferent arterioles - leaves carries blood cells

They are all surrounded by **peritubular capillaries**, which are formed by afferent arterioles.

Condition for primary urine production

- 39
- Pressure should be high
 - Afferent diameter twice wider than efferent.

Reabsorption (98% of water and XXX substances return to blood that goes into capillaries) **occurs in the tubular part**, and **secondary urine** is produced, which is 1 to 2 liters per day. Secondary urine goes to **collecting ducts**, and then it goes to **papillary ducts**, and then it goes to **papillary foramina**, and enters the **minor calyces**, and then it goes to **major calyces**, and then it goes to **renal pelvis** and then it finally goes to **ureters**. This process is called **urine excretion**.

Secondary urine → collecting ducts → papillary ducts → papillary foramina → minor calyces → major calyces → renal pelvis → ureters

Urine production consists of 3 processes:

- **filtration**: occurs in the renal corpuscle
- **reabsorption**: occurs in the tubular part
- **excretion**: occurs in collecting ducts, papillary ducts, papillary foramina, minor calyces, major calyces, and renal pelvis

Types of nephrons:

→ afferent diameter X2 wider than efferent

cortical nephron: renal corpuscle convoluted tubules of cortical nephron are located in the **cortex**. Only **loop of Henle** and **collecting ducts** are inside the **pyramids** in the **medulla**.

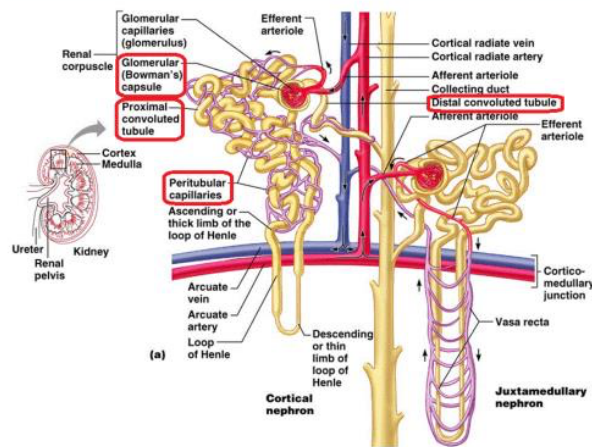
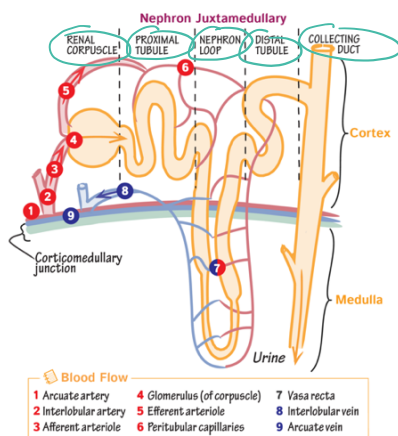
What is main/specific feature of cortical nephron? Afferent arterioles **are by there** to efferent arterioles. This increases **intraglomerular pressure** and **helps filtration of blood**.

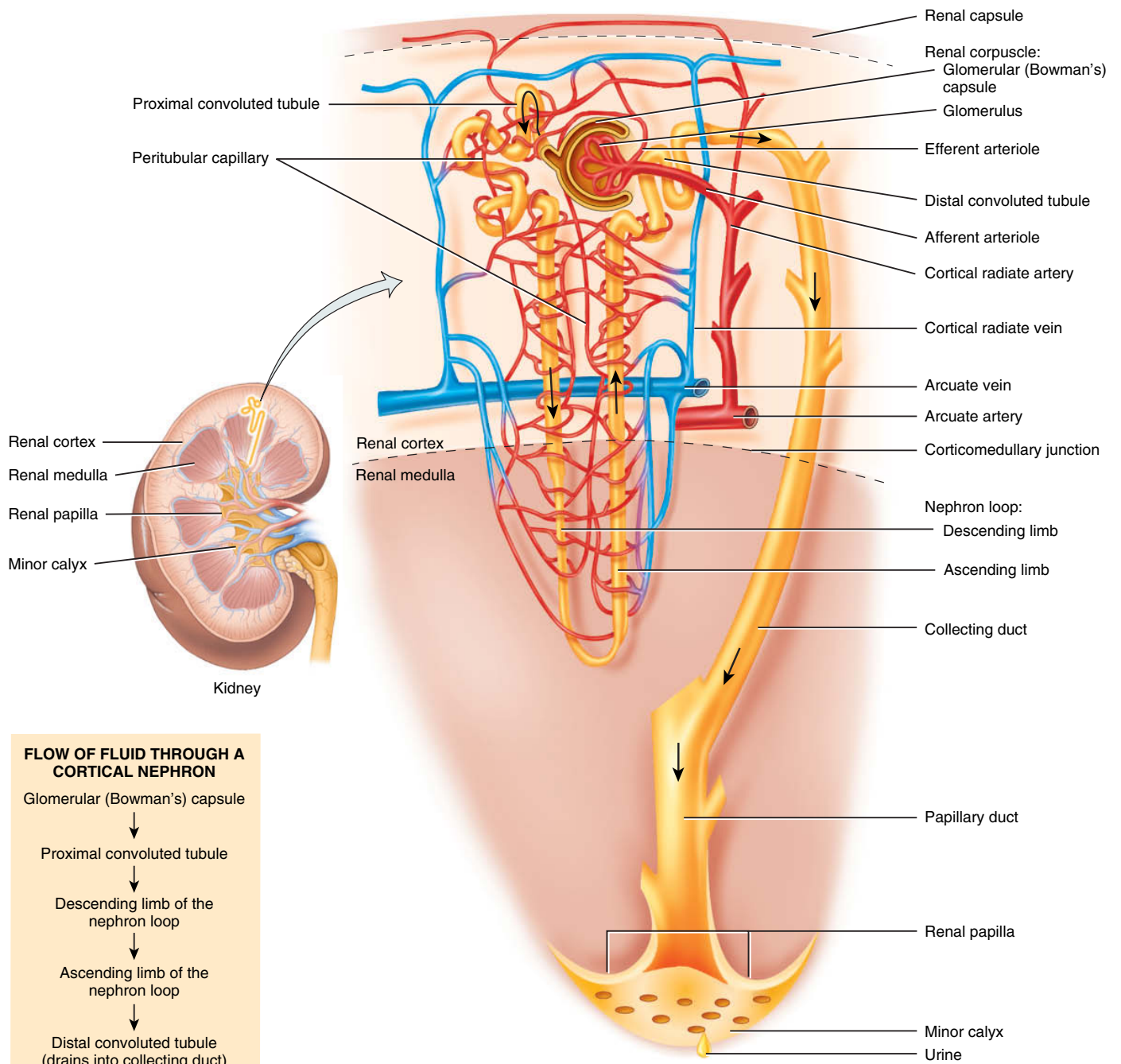
cortical nephron has **juxtaglomerular apparatus**, which consist of **myoepithelial cells** in the afferent arterioles and in the distal convoluted tubules which is called **macula densa**, and these cells produce **rene** which increases blood pressure.

→ they are sleeping only activated when pressure increases too much

juxtamedullary nephrons: are located in the columns near the medulla (juxta means near), and afferent and efferent arterioles are the same in the juxtamedullary nephrons. They are non-functioning nephrons and they begin their functions only in high blood pressure persons.

both same diameter and no absorption of minerals

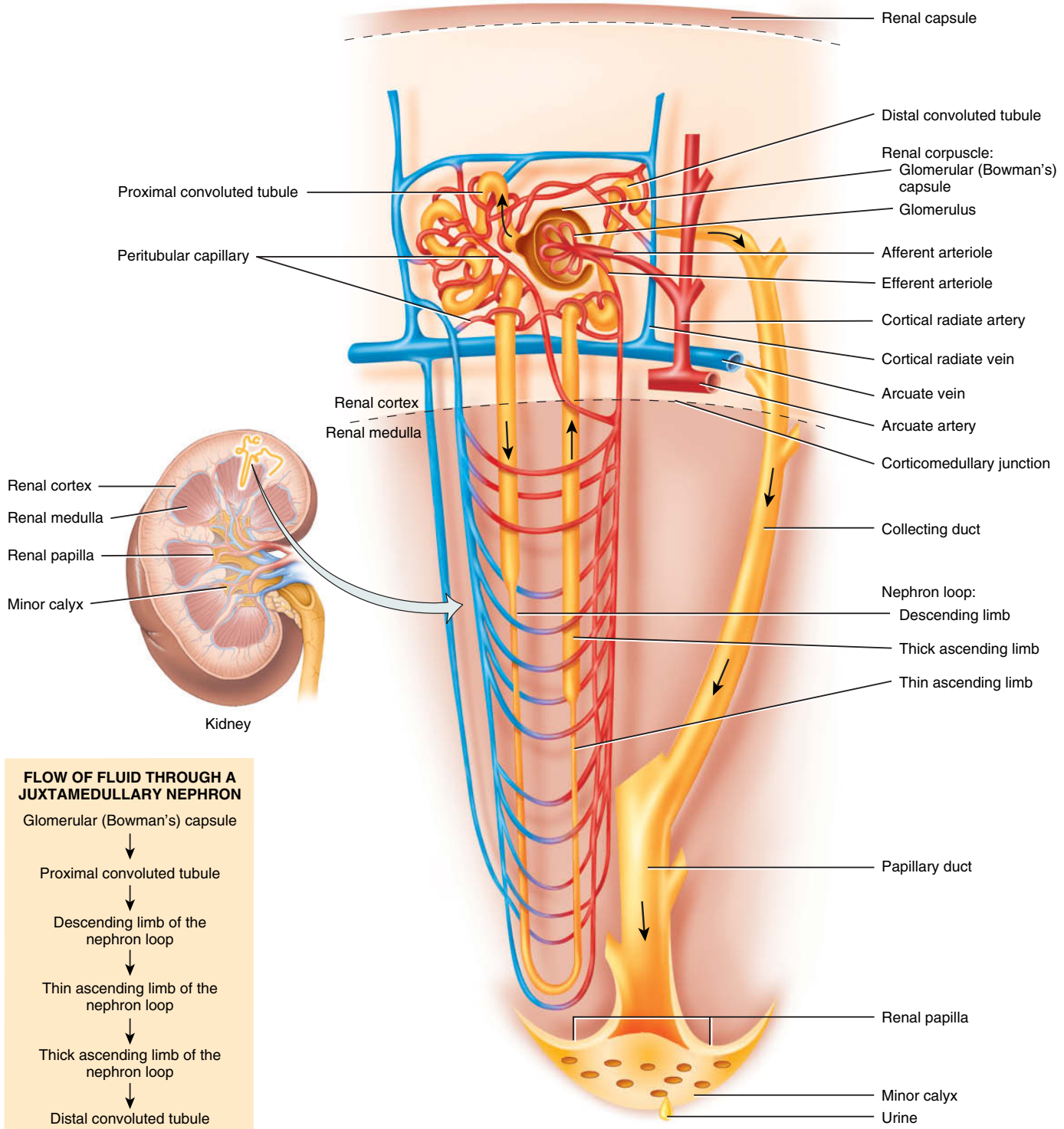




(b) Cortical nephron and vascular supply

Figure 26.5 Continues

FIGURE 26.5 Continued



(c) Juxtamedullary nephron and vascular supply

Q What are the basic differences between cortical and juxtamedullary nephrons?

Cortical nephrons have glomeruli in the superficial renal cortex, and their short nephron loops penetrate only into the superficial renal medulla. Juxtamedullary nephrons have glomeruli deep in the renal cortex, and their long nephron loops extend through the renal medulla nearly to the renal papilla.

Ureters: are paired organs, approximately **30cm long**, that originates **from renal pelvis** and **descends from abdominal cavity to pelvic cavity** and **enters the urinary bladder**.

Ureters are **retroperitoneal organs**, and consists of **abdominal part** and **pelvic part**. Wall of ureters consists of 4 layers mucosa, submucosa, muscularis and outer is adventitia.

Mucosa contains **longitudinal folds**, and **ureteral glands**. **Muscular** consists of three layers **outer and inner are longitudinal** and **middle is circular**, and the **outer covering is adventitia**.

Urinary bladder: is **reservoir of urine** which is located in the **pelvic cavity** behind the pubic symphysis.

Urinary bladder consists of 4 parts:

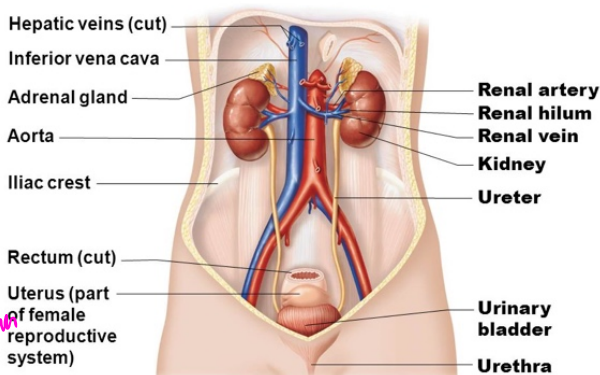
- **body**
- **fundus**
- **cervix**
- **apex**

Syntropy of urinary bladder:

- **anterior** to urinary bladder is **pubic symphysis**,
- **posterior** to urinary bladder in males is **rectum** and in females is **uterus** and **vagina**.

Wall of urinary bladder contains **3 ostia** (openings). **2 openings are for ureters**, because ureters enter the urinary bladder and carry urine, and the **third opening is urethral opening** from which urethra starts.

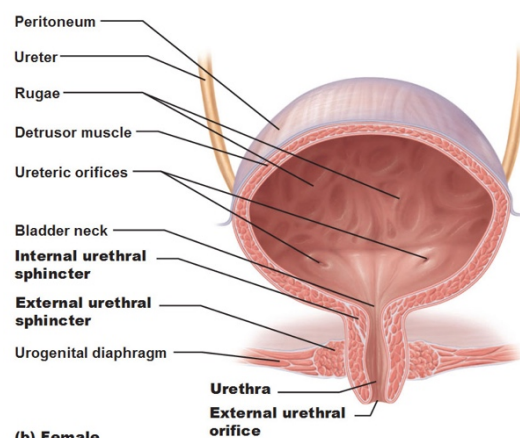
Figure 15.1a Organs of the urinary system.



(a)

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Urinary Bladder and Urethra – Female



(b) Female

Wall of urinary bladder: consists of **mucosa**, **submucosa**, **muscularis** and **outer covering is partly peritoneum** and **partly adventitia**. **Mucosa of urinary bladder** is covered by **transitional epithelium** and **contains irregular folds** except **trigon of urinary bladder** which is a **triangular region** between **urethra** and **ureters** and **urethral ostium**.

At this region (trigon) we don't have any folds because there is **no submucosa**. **Muscular coat** consists of **outer and inner longitudinal** and **middle circular**.

No folds

Empty - **extraperitoneal** only 1 wall is covered

Full - **mesoperitoneal** all covered except 1 wall

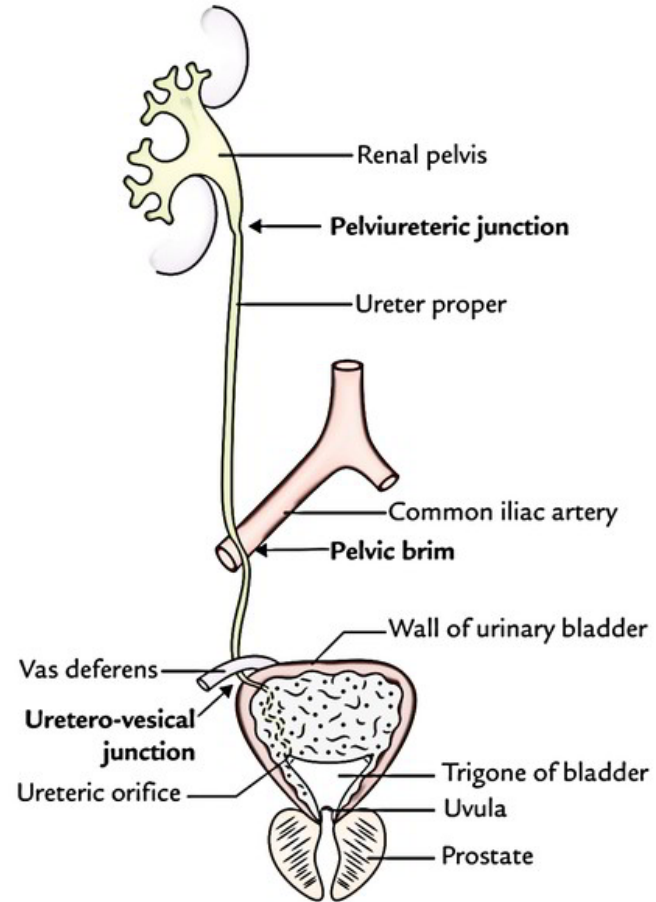
Ureteric constrictions

Narrow part

Ureteropelvic junction

Pelvic brim

Vesicoureteral junction



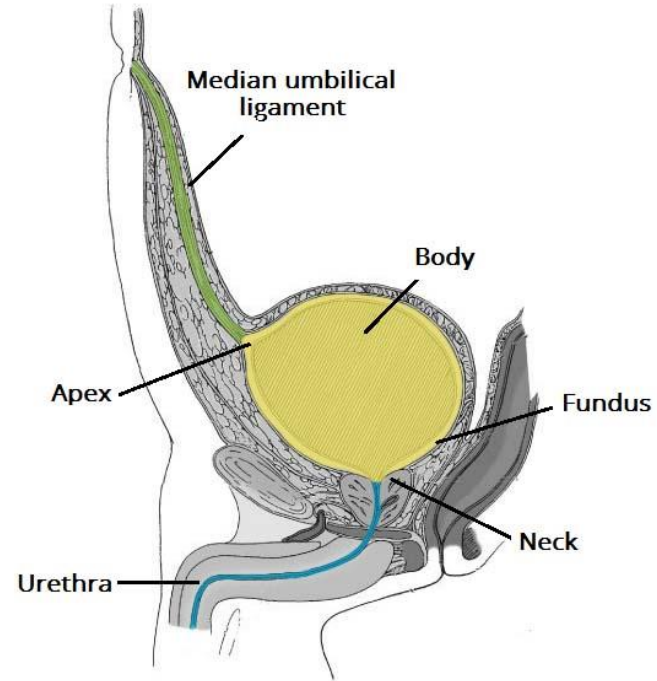
Urinary Bladder

Apex

Fundus

Body

Neck

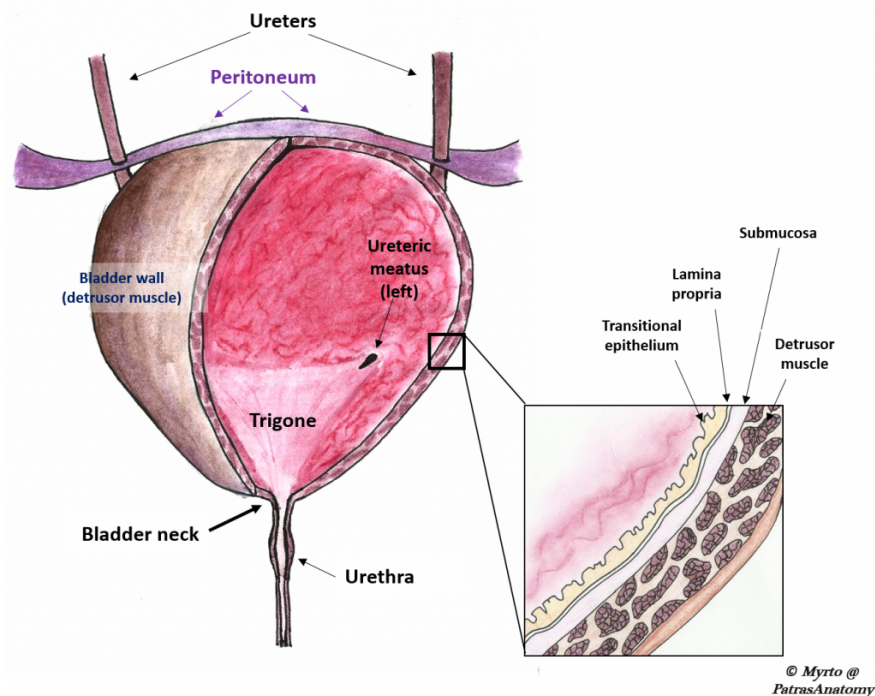


These muscular layers make the following muscles:

- pubovesicalis,
- rectovesicalis,
- rectourethralis, and
- **detrusor muscle.**

→ contracts to produce urine

detrusor muscle is the strongest muscle which is formed by the circular layer of urinary bladder, and the **function of detrusor muscle** is **urination**.



Female urethra: which is **very short**, approximately **4cm** in length, and starts **from internal opening/ostium of urethra** in the wall of urinary bladder, and it **ends in the external ostium** which is in front of the vaginal XXX.

Wall of female urethra consists of mucosa, submucosa, muscular layers. Mucosa has longitudinal folds and glands. Muscular coat consists of **inner longitudinal** and **outer circular** layer which **connects to muscles of urogenital diaphragm** which forms **urethral sphincter**.