

KIDNEY

URETER

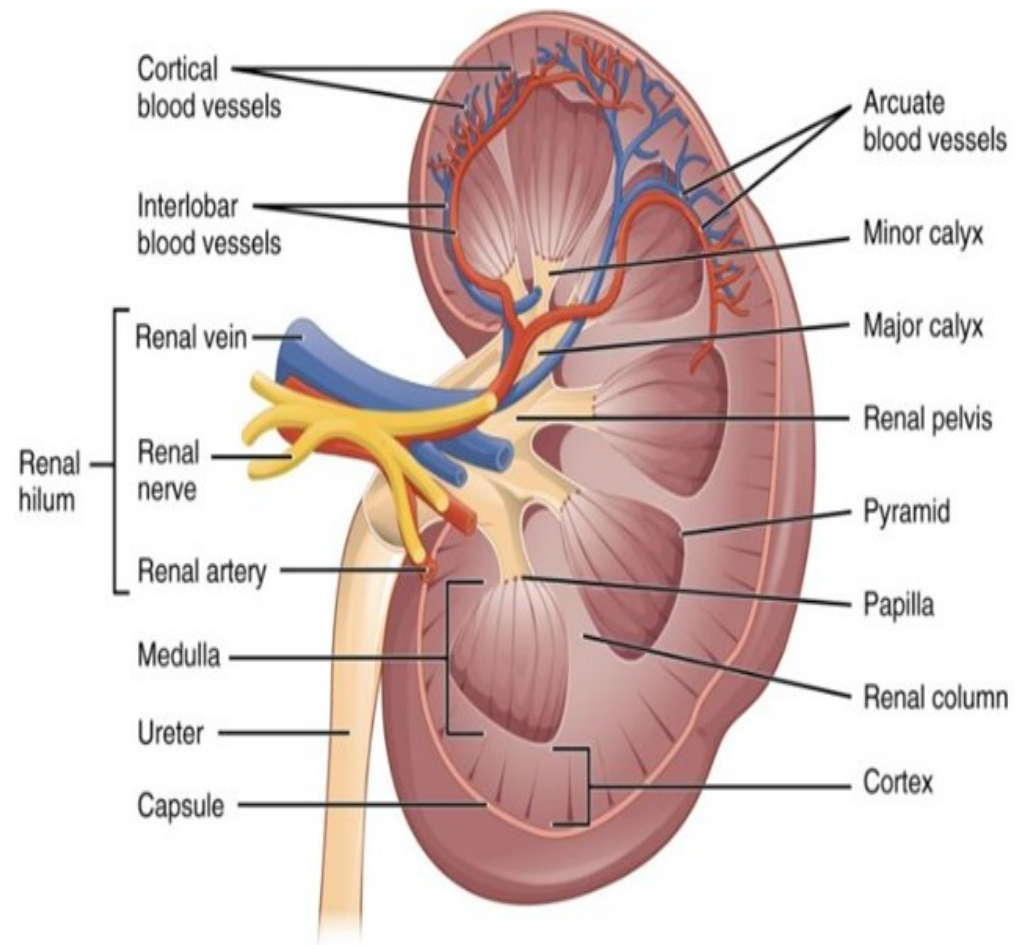
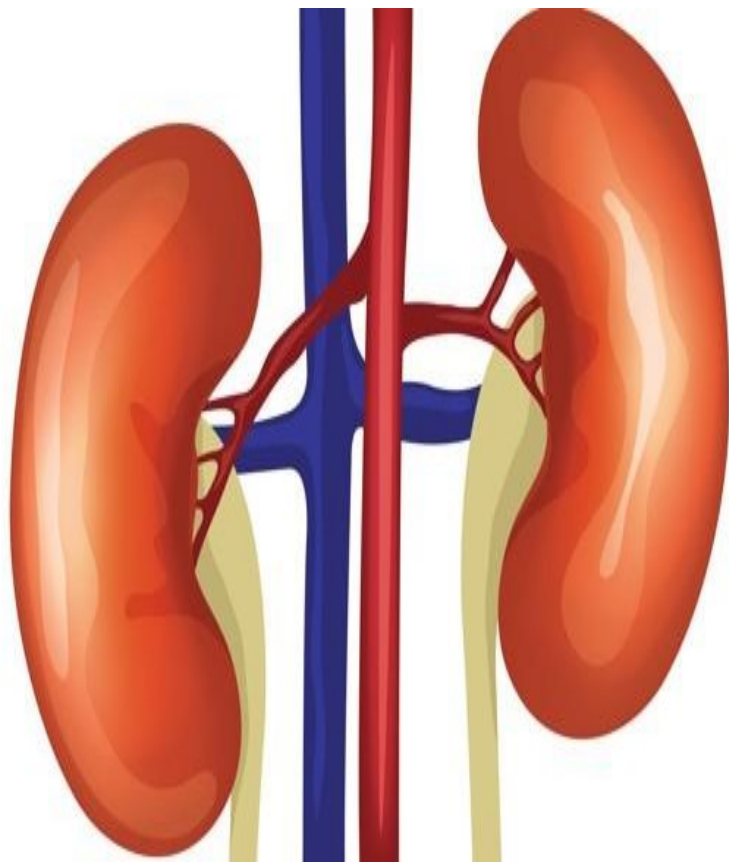
BLADDER

URETHRA

URINARY SYSTEM STRUCTURES

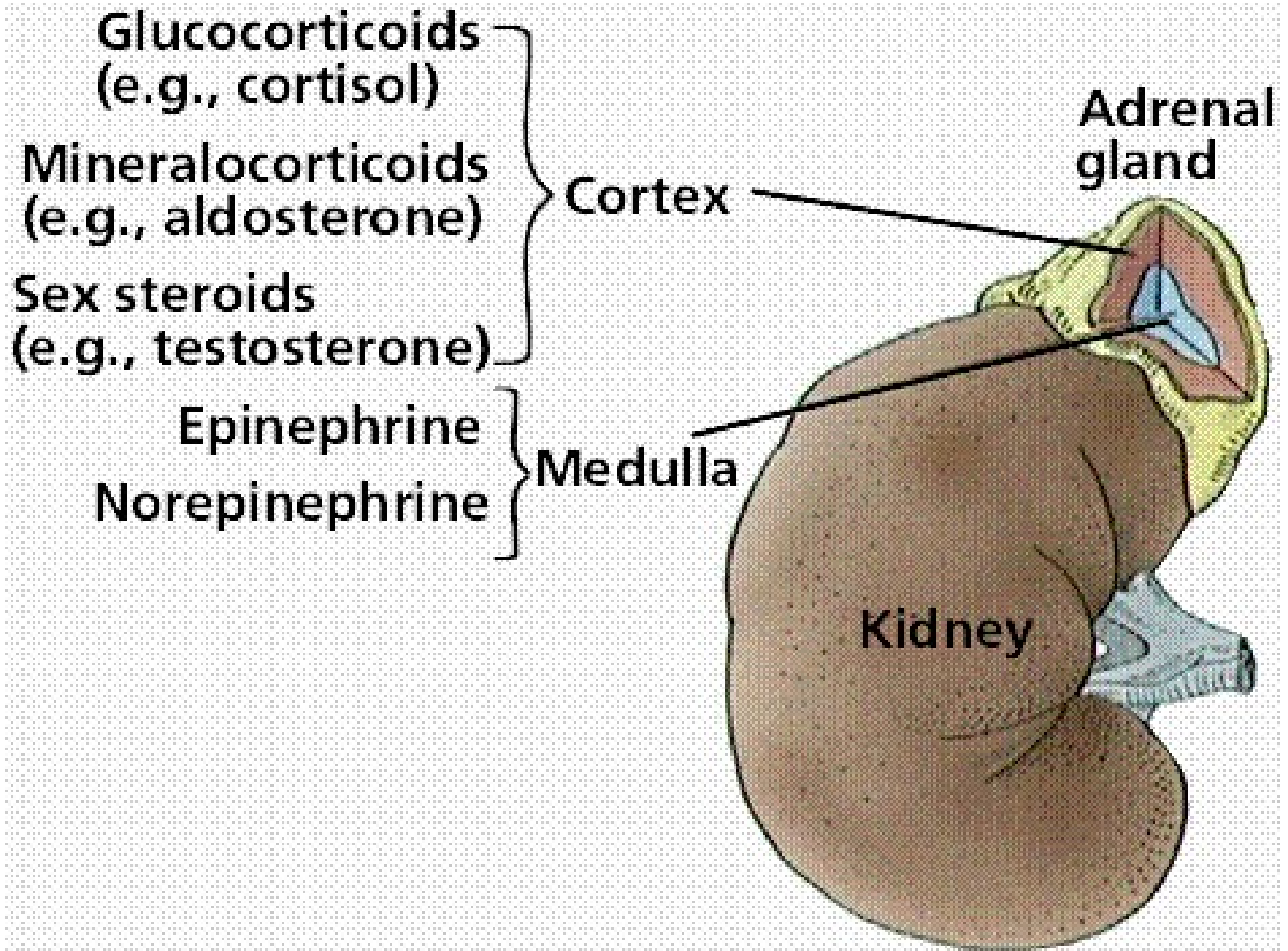
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Kidney



Introduction

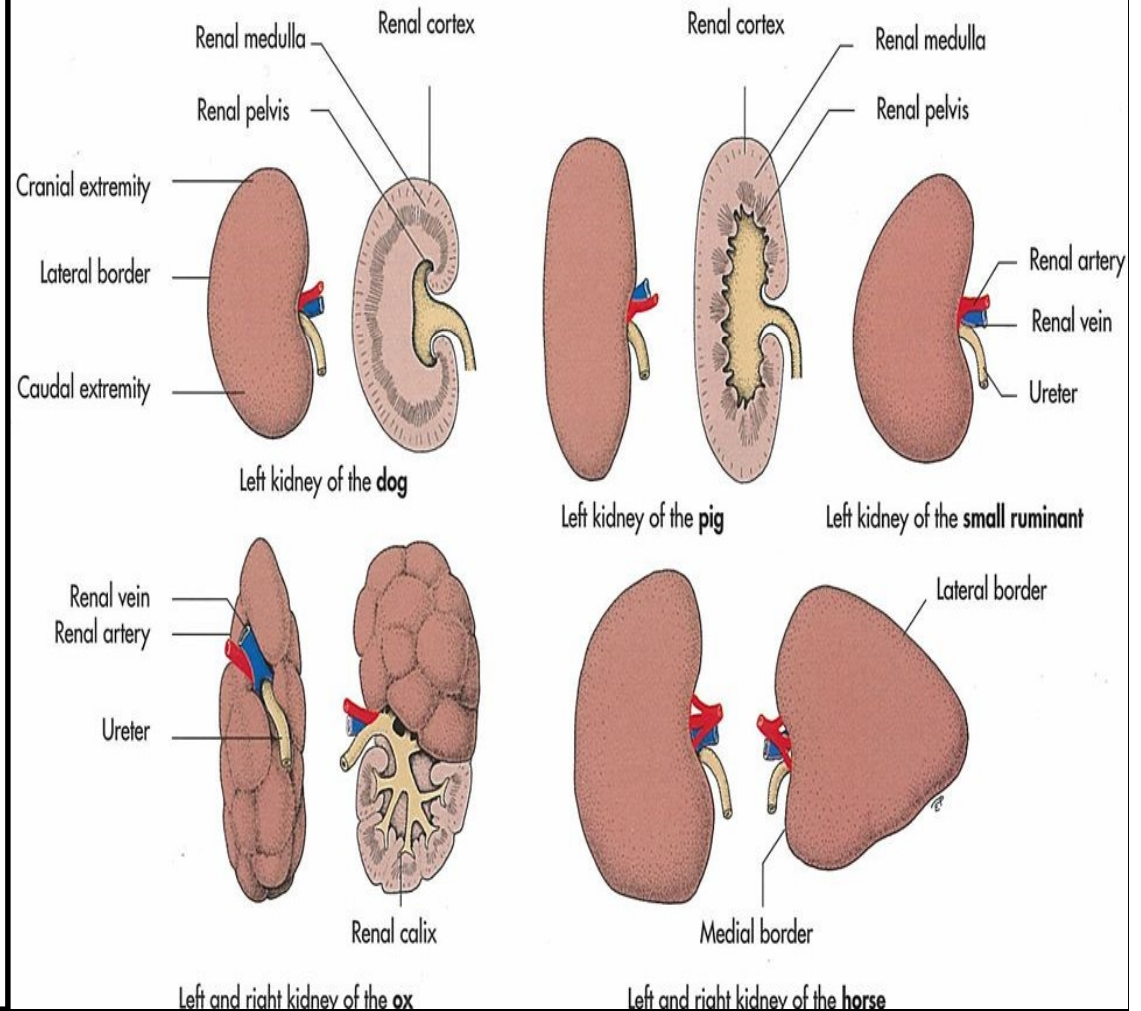
- kidneys remove waste products and excess fluid from the body. These waste products and excess fluid are removed through the urine. The production of urine involves highly complex steps of excretion and reabsorption.
- The kidney perform the following functions:-
 - Remove waste products from the body
 - Remove drugs form the body
 - Release hormones that regulate blood pressure
 - Produce an active form of vitamin D that promotes strong, healthy bones
 - Control the production of red blood cells



Types of kidney

- 1. Unilobular kidney:-**
Smooth surface & single renal papillae.
E.g. Small ruminants, horse, dog, cat.
- 2. Multilobar kidney:-**
Smooth surface & Multiple papillae.
E.g. Pig
- 3. Multilobular kidney:-**
Lobulated surface & Multiple papillae.
E.g. Ox

Difference of kidney among the animals



1. OX

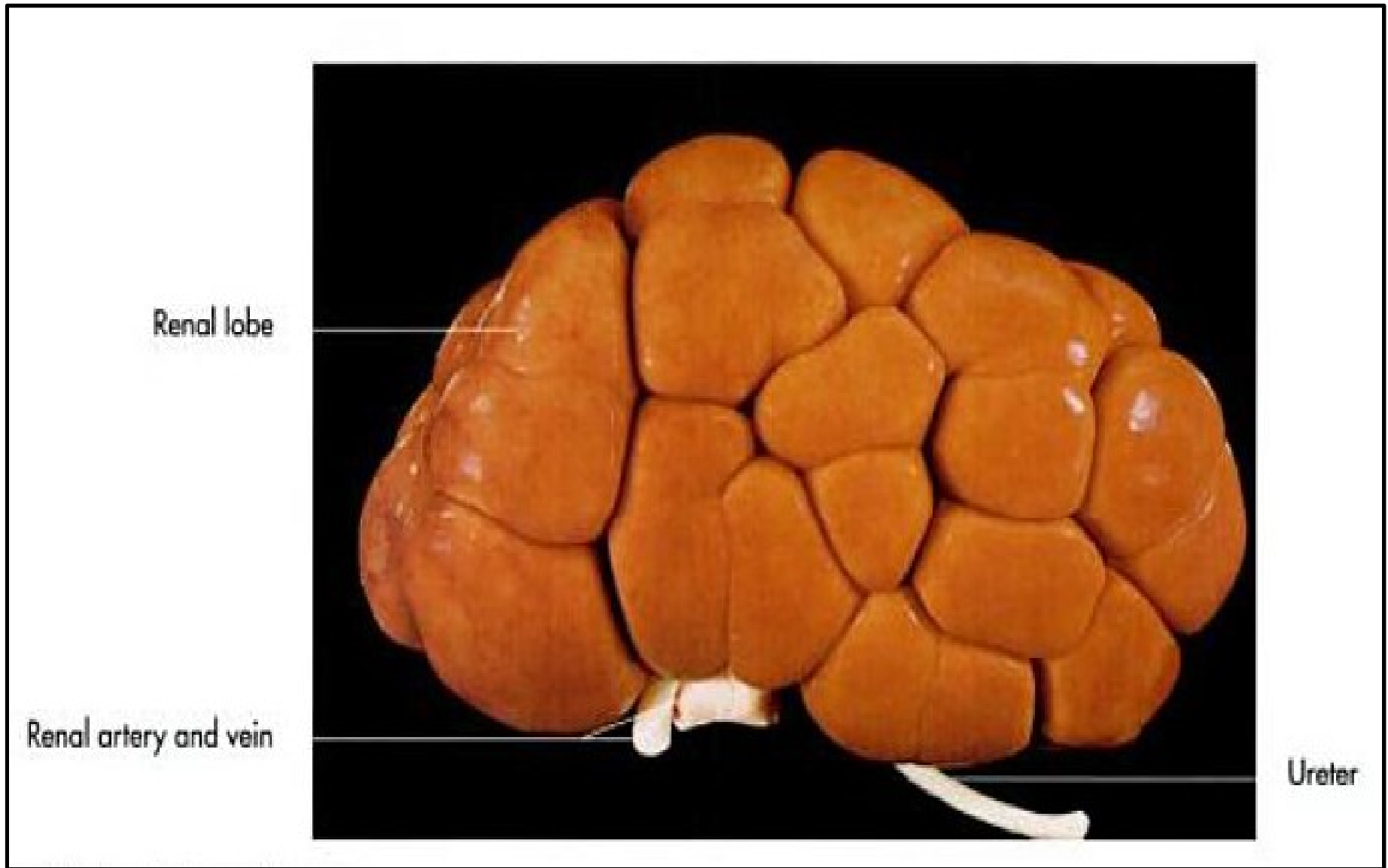
- Paired, Reddish brown in colour
- **Shape:-** Oval/Bean
- **Position:-** Either side of vertebral column, caudal to abdomen,
- Surface is marked by polygonal lobes about 20 in number ,filled with fat
- Average weight 600 to 700 gm.
- Left one usually heavier than the Right.
- Right kidney 20 to 22.5 cm long, 10 to 12 cm wide 5 to 6 cm thick
- The left one is slightly shorter but thicker

RIGHT KIDNEY

- **Position:-** Below the proximal end of last rib and the L2-L3 transverse processes
- **2 Surfaces:-** **Dorsal** surface is rounded and is in contact with the sublumbar muscles, while **ventral** surface is less convex and related to the liver, pancreas, duodenum and colon
- **2 Borders:-** The **medial border** is straight and lies parallel to the abdominal venacava, while The **lateral border** is convex
- **2 Extremities:-** The **cranial extremity** is thick, lies in the renal impression of the liver and is related to the adrenal. The **caudal extremity** is narrow and pointed.
- The **hilus** is an elliptical cavity situated at the **cranio-medial** aspect of the ventral surface

LEFT KIDNEY

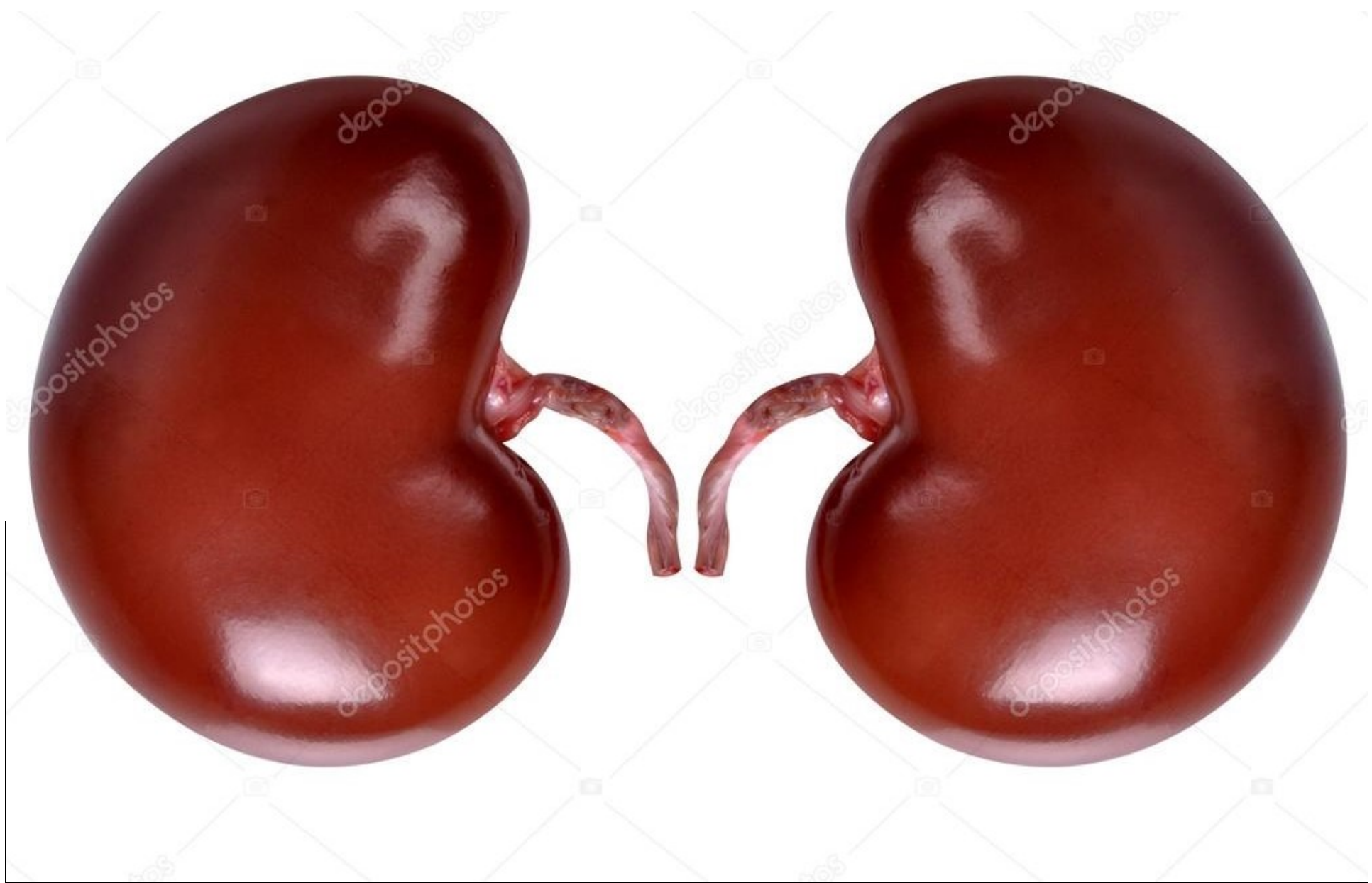
- **Position:-** It is variable in position, When the rumen is **full**, it present **below and behind the right kidney** at the level of **3rd 4th and 5th** lumbar vertebrae , When the rumen is not so full, it is slightly towards the left.
- It presents three surfaces
- The **dorsal surface** is convex and is related to the sublumbar muscles, hilus present at cranial part
- The **ventral surface** is less convex and is related to the intestine
- The **lateral surface** is flattened due to its contact with the rumen and is hence termed the **ruminal surface**
- The **medial border** is nearly straight and is related to the abdominal aorta and ureter



OX KIDNEY (LOBULATED)

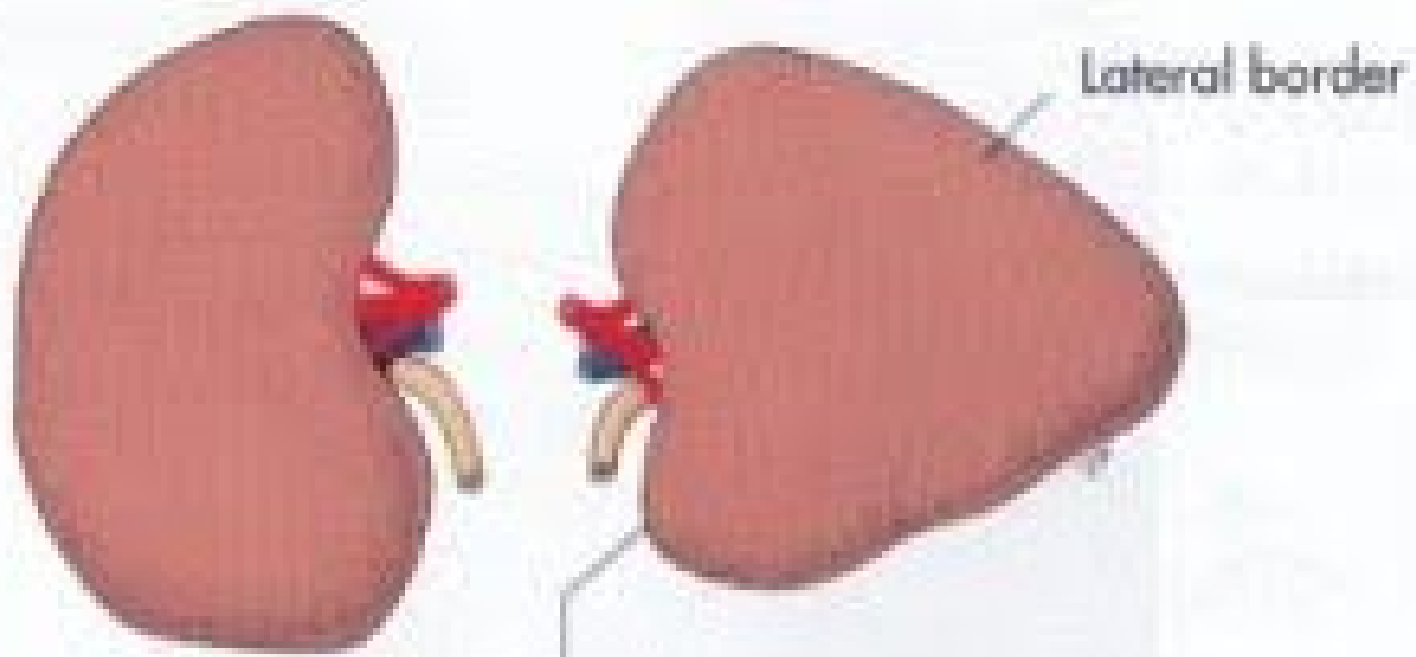
1. Sheep and Goat

- The kidneys are bean shaped and smooth
- In position, they resemble ox except that the right one is usually a little further back and lies under the **first three lumbar transverse process**



2. Horse

- The surfaces are smooth and are not lobulated.
- Position:- **Right** kidney:-Below the proximal end of the **last 2-3 ribs and 1st lumbar transverse process**
- The **left** one is below the proximal end of **last rib**.
- The average weight is about 700 gm.
- The right kidney weighs is more than the left.
- The right kidney is **heart** shaped while the left is **bean** shaped



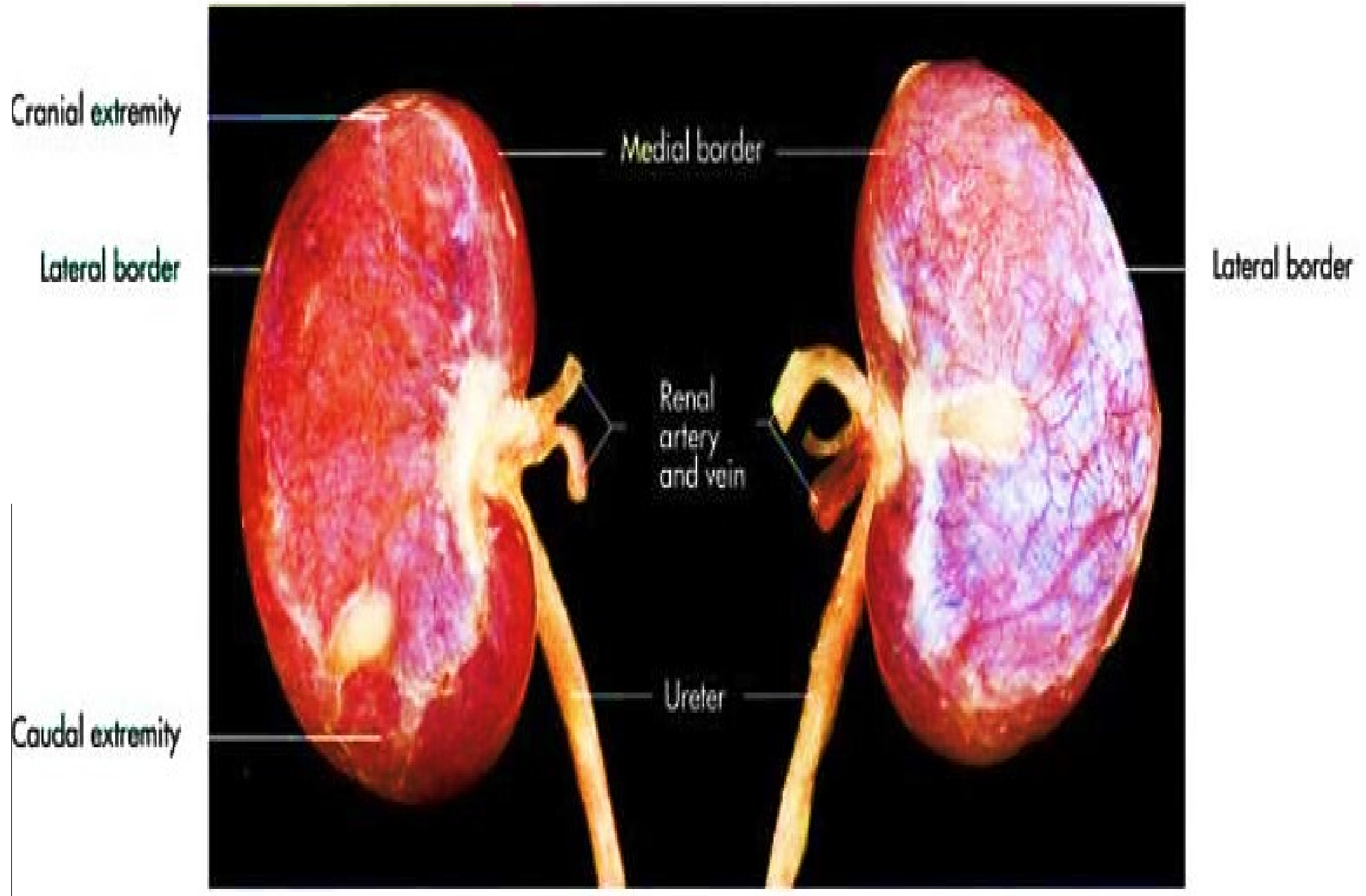
Lateral border

Medial border

Left and right kidneys of the horse

3. Dog

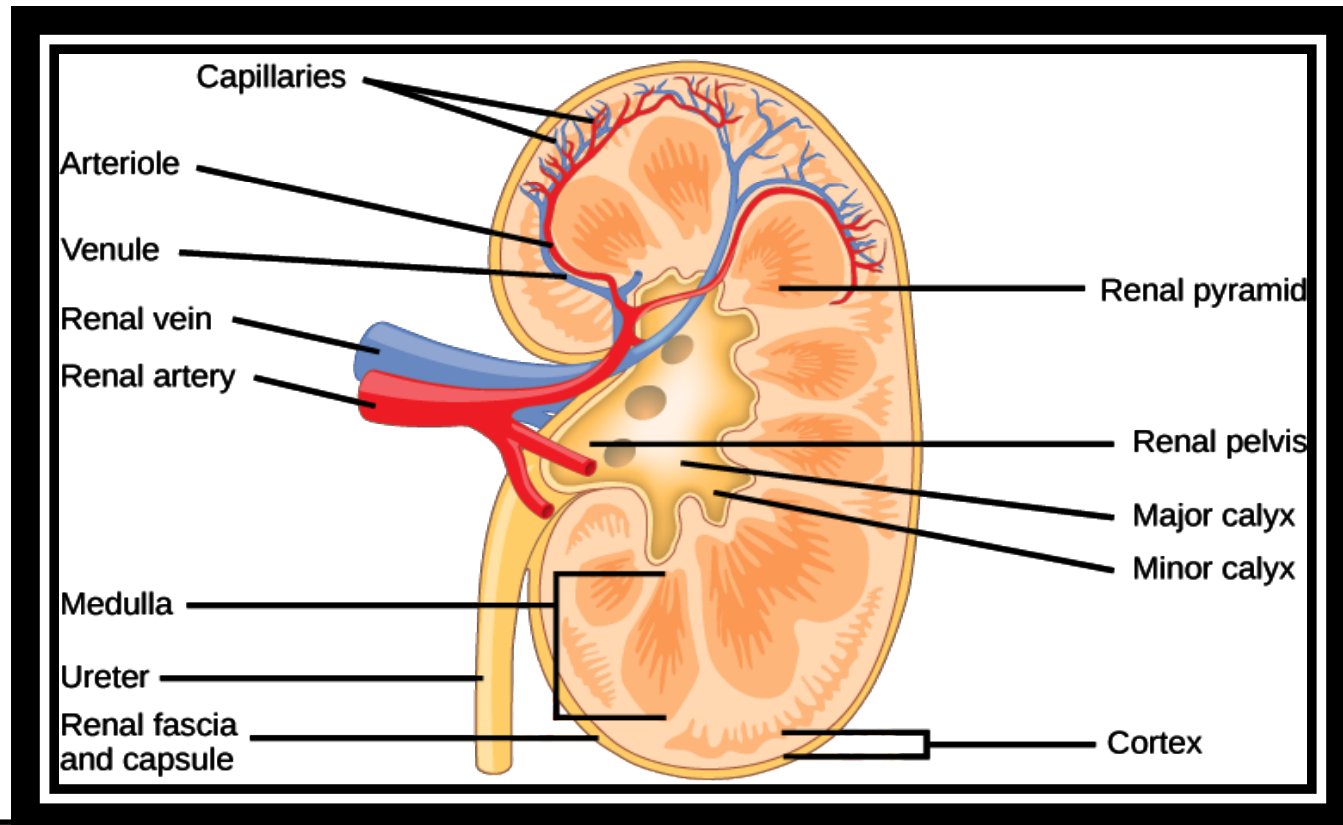
- The kidneys are smooth and bean shaped.
- The average weight is 50 to 60 gm.
- Position:-
 - ✓ **Right kidney** is situated under the **bodies of the first three lumbar vertebrae**
 - ✓ **Left kidney** variable in position, when the stomach is full-At the level of 3rd-5th **lumbar vertebrae**, Empty stomach- At 2nd-4th lumbar vertebrae
- Hilus present at middle of medial border



Dog Kidneys (dorsal aspect)

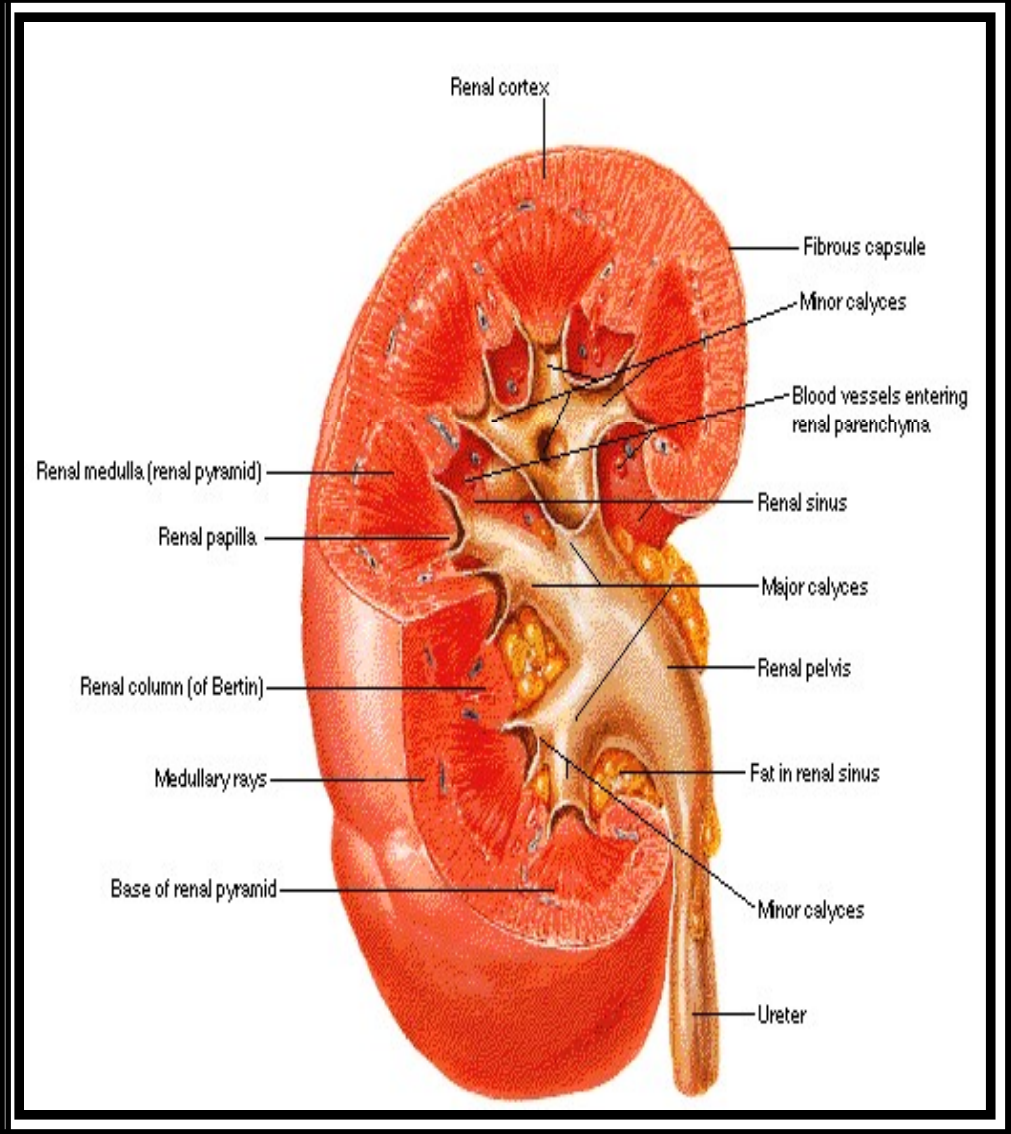
Renal capsule:-

- Outer protective covering on each kidney. composed of tough, collagen and elastin fibres that help to support the kidney.
- When the kidney cut longitudinally, exhibits two distinct zone:-
Cortex, Medulla



Cortex

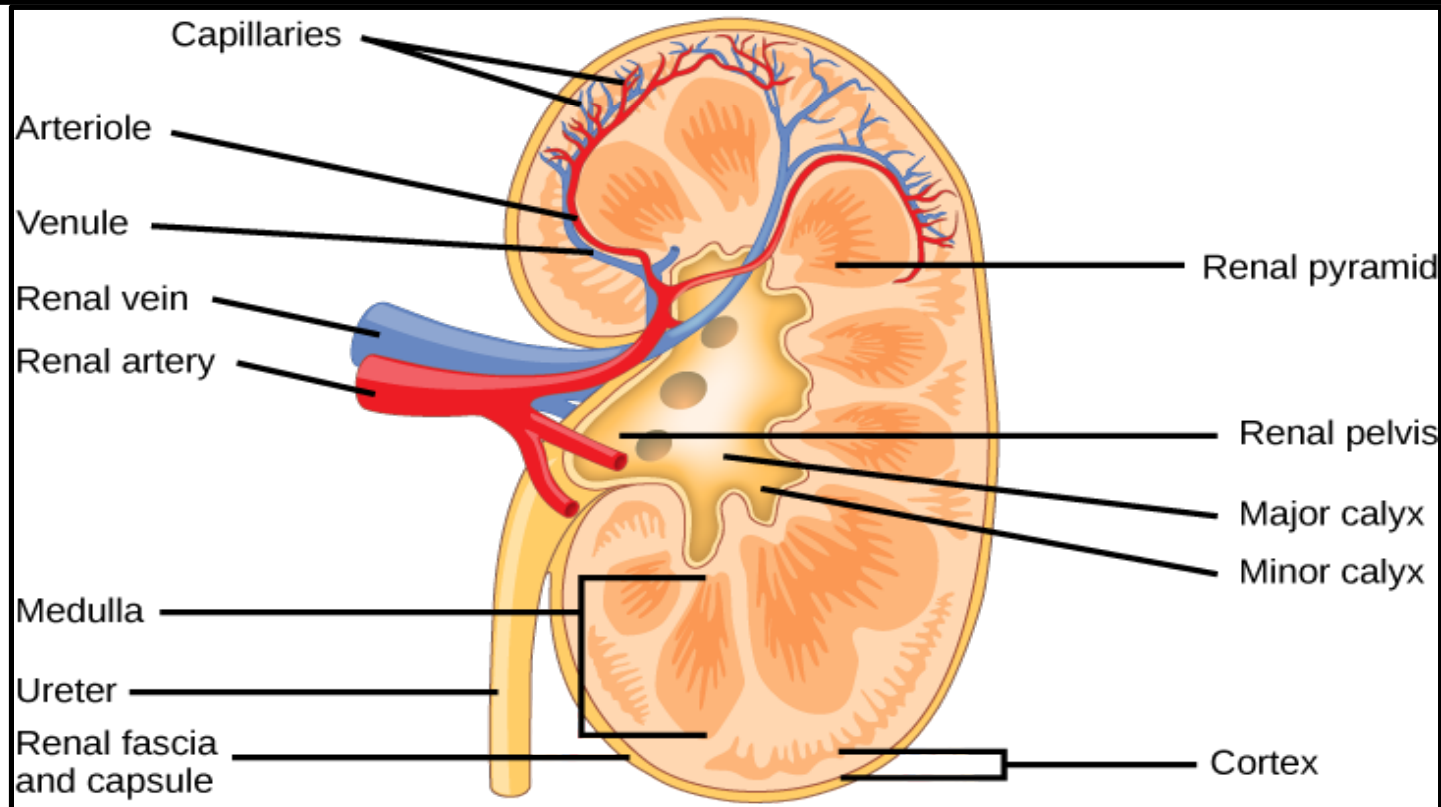
- This is **dark** peripheral zone contain **renal** or **Malphigian corpuscles (dark red dots)**, renal tubules (P.c.t.,D.c.t.&c.t.) and blood vessels.
- The **bovine** kidney is grossly divided into lobes, each of which communicates with a minor calyx.
- The renal cortex of the **equine, ovine, and caprine** kidney **lacks visible** divisions into individual lobes.



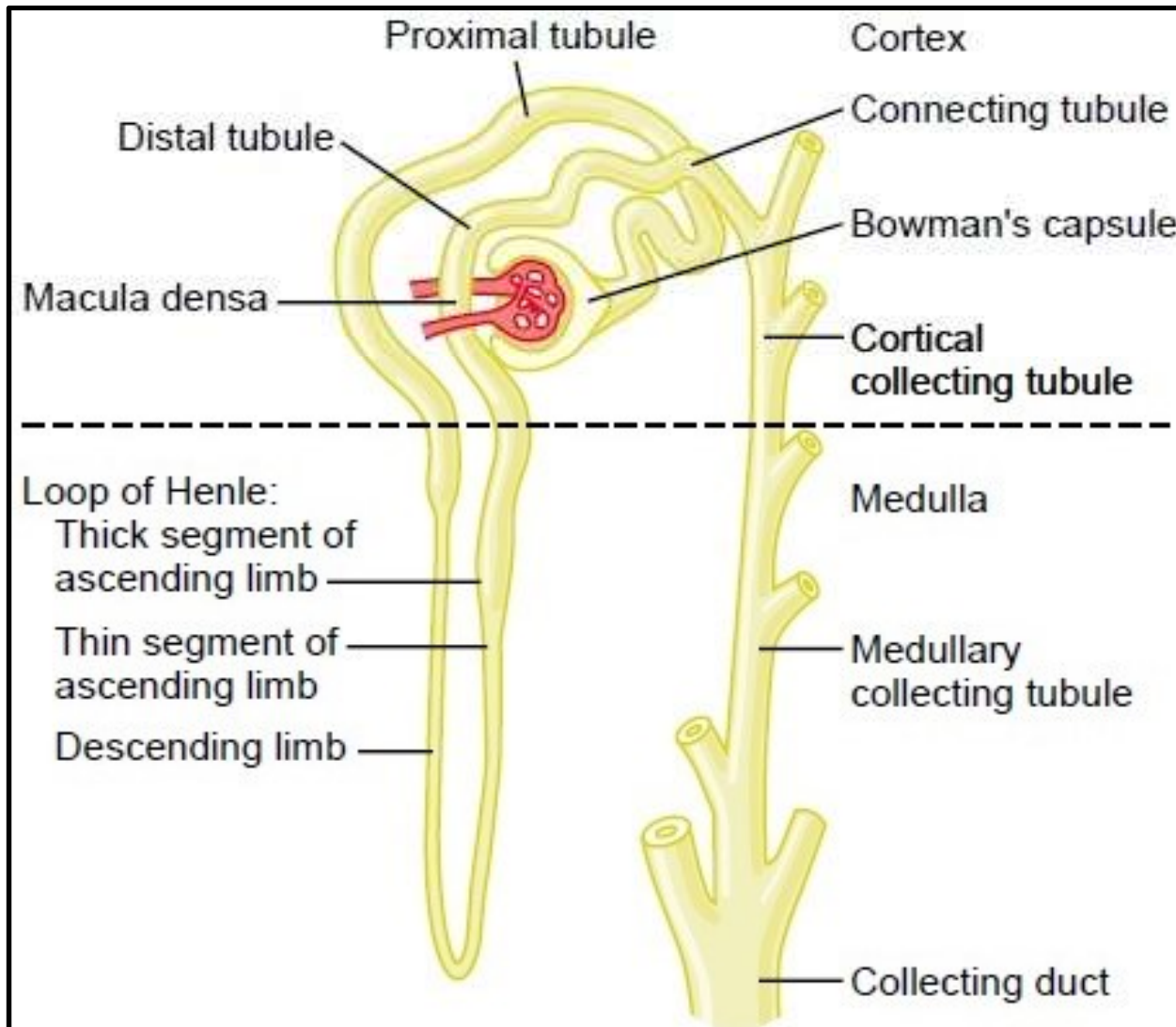
Medulla

- The Medulla is the innermost part of the kidney, with lighter zone and parallel streaks. The renal medulla is split up into a number of sections into triangular area (20 in number), known as the **renal pyramids**,
- It contains the **loop of Henle** and **collecting duct** of nephron.
- The pointed end of renal pyramids called **renal papillae**
- Renal-papilla is enclosed by the funnel-shaped end of a tube known as the **calyx minor**, which opens into a larger **calyx major**.
- In equine, ovine, and caprine kidney renal papillae are fused.

- At the medial aspect of each kidney **hilus** present, where arteries and nerves enter the kidney, and the ureter, veins, and lymphatic vessels leave and calyx major opens.
- The wide origin of the ureter in the kidney is the **renal pelvis**. The cavity in the kidney that contains the pelvis is the **renal sinus**
- The excretory duct (ureter) starts from renal pelvis.
- **The bovine kidney does not have a renal pelvis, the ureter instead arising directly from the integration of individual calyces.**



NEPHRON



Introduction

- The nephron is the structural and functional unit of the kidney. Each adult kidney contains around one million nephrons.
- **The nephron utilizes four processes to alter the blood plasma which flows to it: filtration, reabsorption, secretion, and excretion.**
- Filtration occurs in the glomerulus: one-fifth of the blood volume that enters the kidneys is filtered.

Nephron

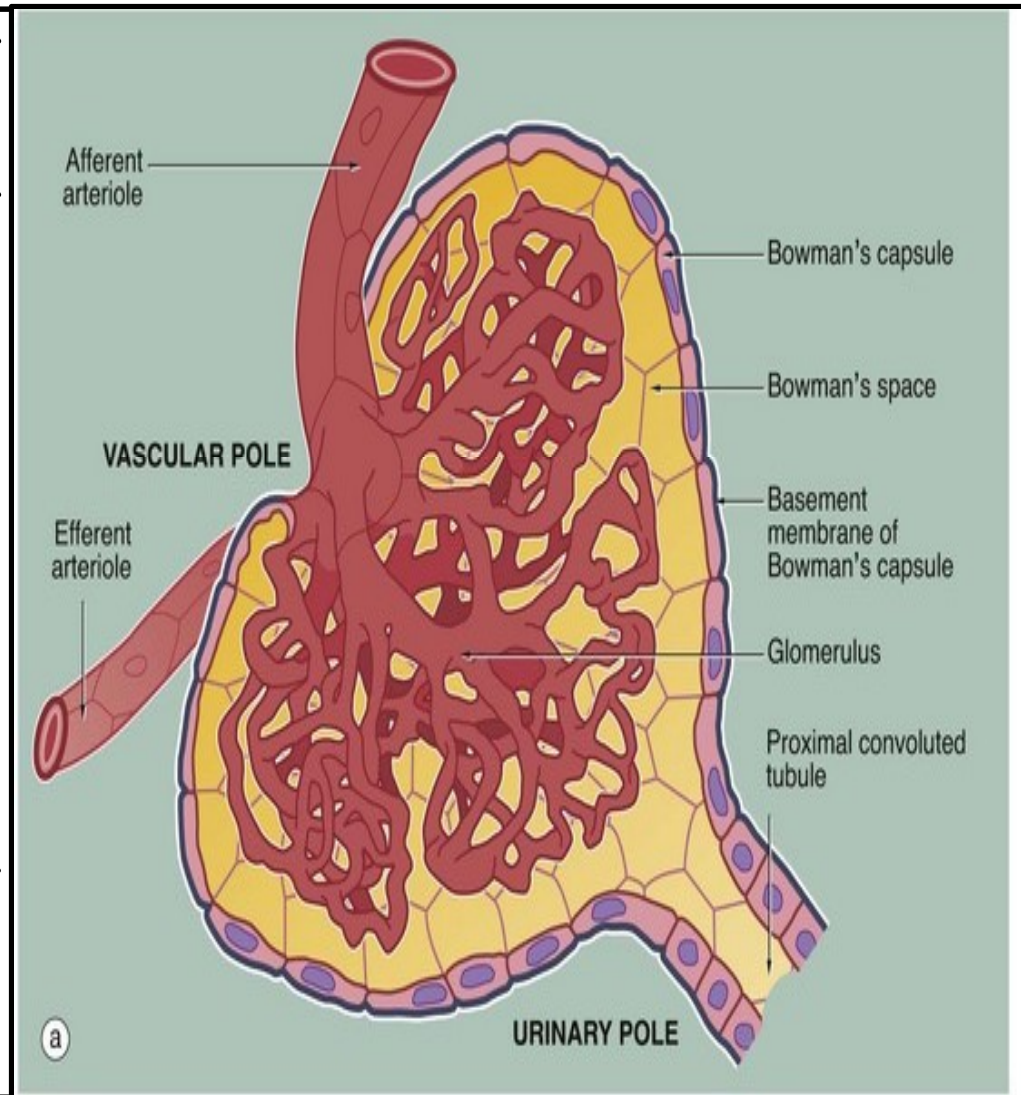
- The nephron is the structural and functional unit of the kidney. Each nephron consists of following parts:-
 1. Renal corpuscle
 2. Renal tubules
 3. Renal vasculature

1. Renal corpuscle

- It is composed of :-
 - A. Bowman's capsule
 - B. Bowman's space
 - C. Juxtaglomerular apparatus
 - D. Glomerulus
 - i) Glomerular capillaries
 - ii) Filtration membrane
 - iii) Podocytes
 - iv) Mesangial cells

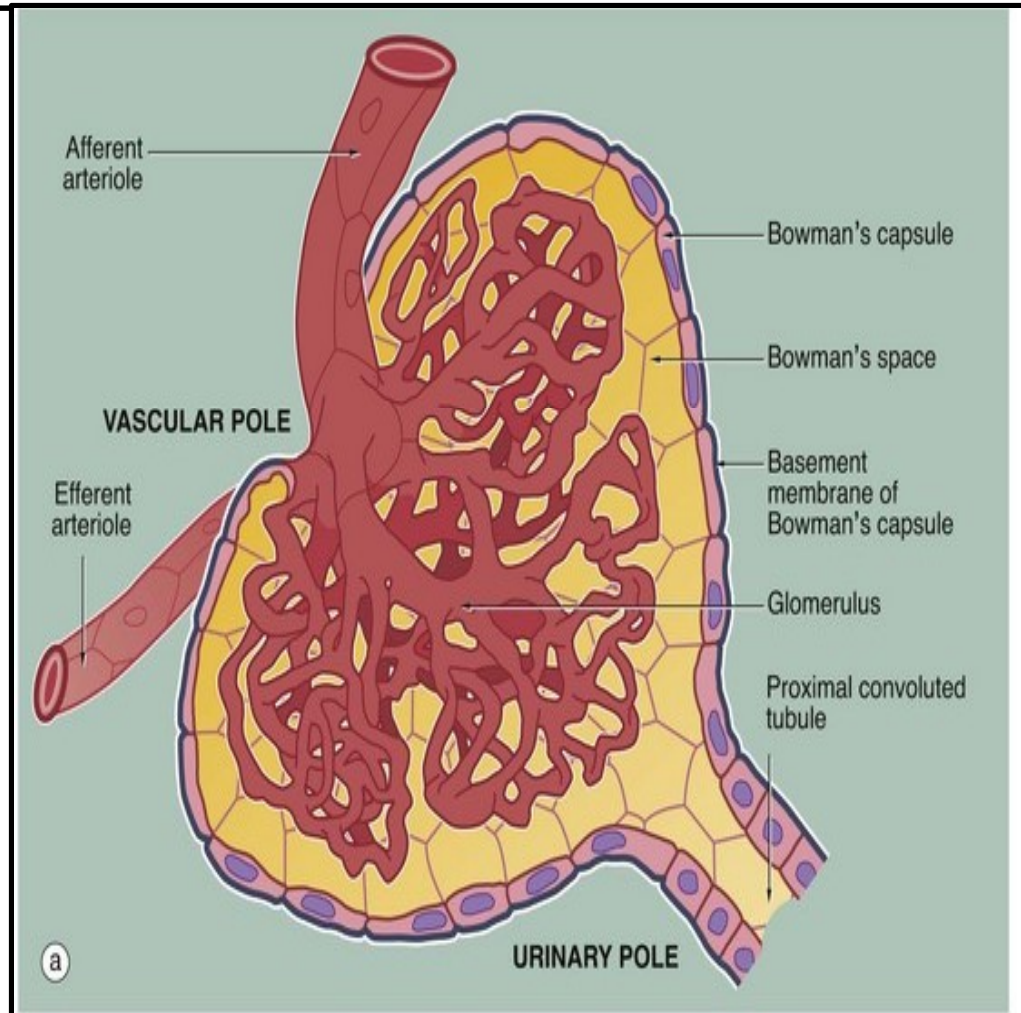
A. Bowman's capsule

- The **outer (parital)** layer of renal corpuscle is called as Bowman's capsule, made up of **simple epithelial** wall.
- **Visceral** layer is formed by **Podocytes**.
- There are 2 poles:-
 - a) **Vascular pole**:- Receive afferent and efferent arterioles.
 - b) **Urinary pole**:- P.C.T. comes out, for the out flow of glomerular filtrate.



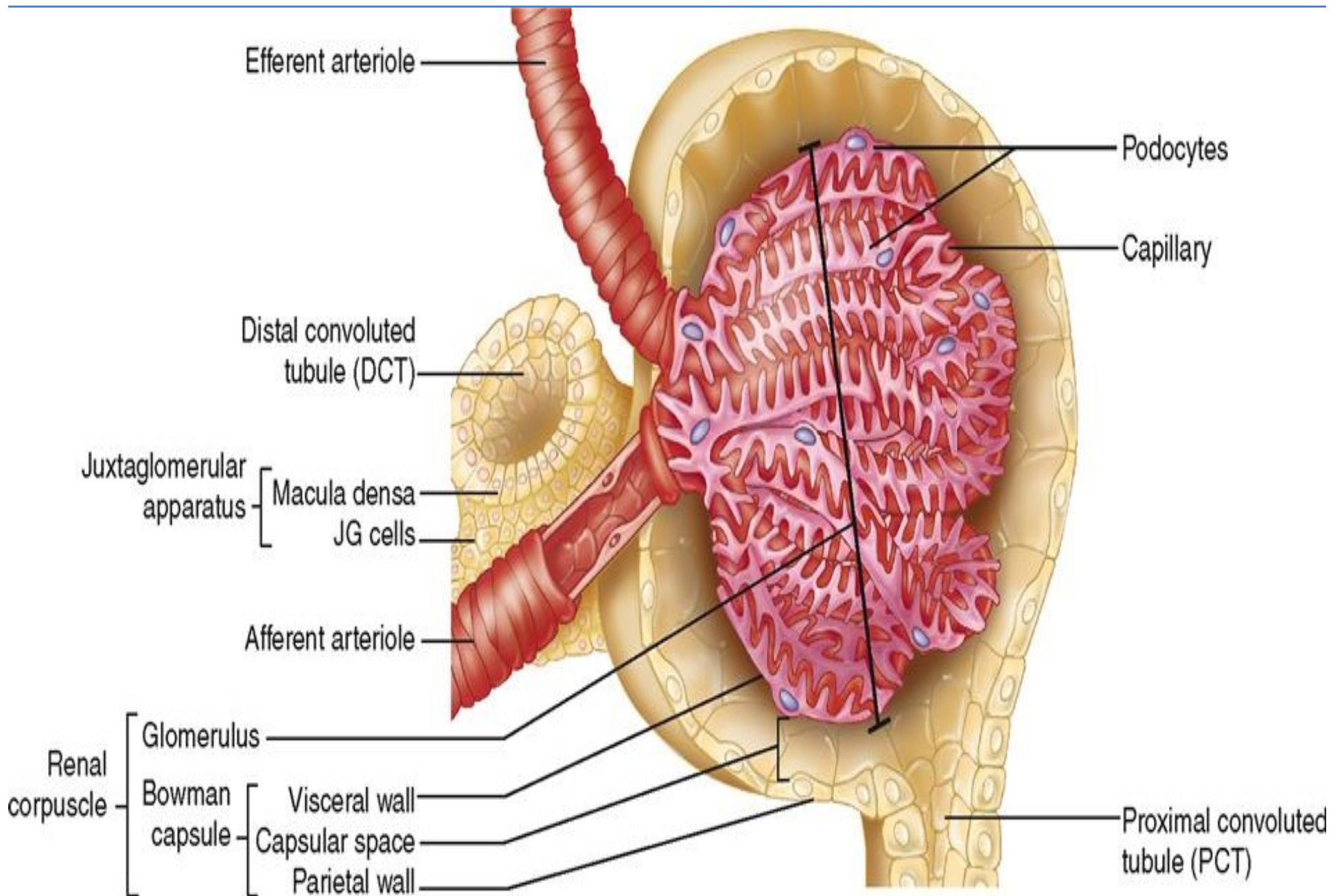
B. Bowman space

- Also called **Urinary space**.
- It is space between **bowman's capsule** and **glomerulus**. It surrounds loop of glomerulus.
- It collect glomerular plasma, filtered by filtrating membrane.



C. Glomerulus

- It is a small ball of capillary suspended within bowman's capsule.
- It is the source of initial filtrate of plasma that is eventually processed into urine.
- It is composed of following parts:-
 - I. Glomerulus capillaries**
 - II. Filtrating membrane**
 - III. Podocytes(footed cells)**
 - IV. Mesangial calls and matrix**



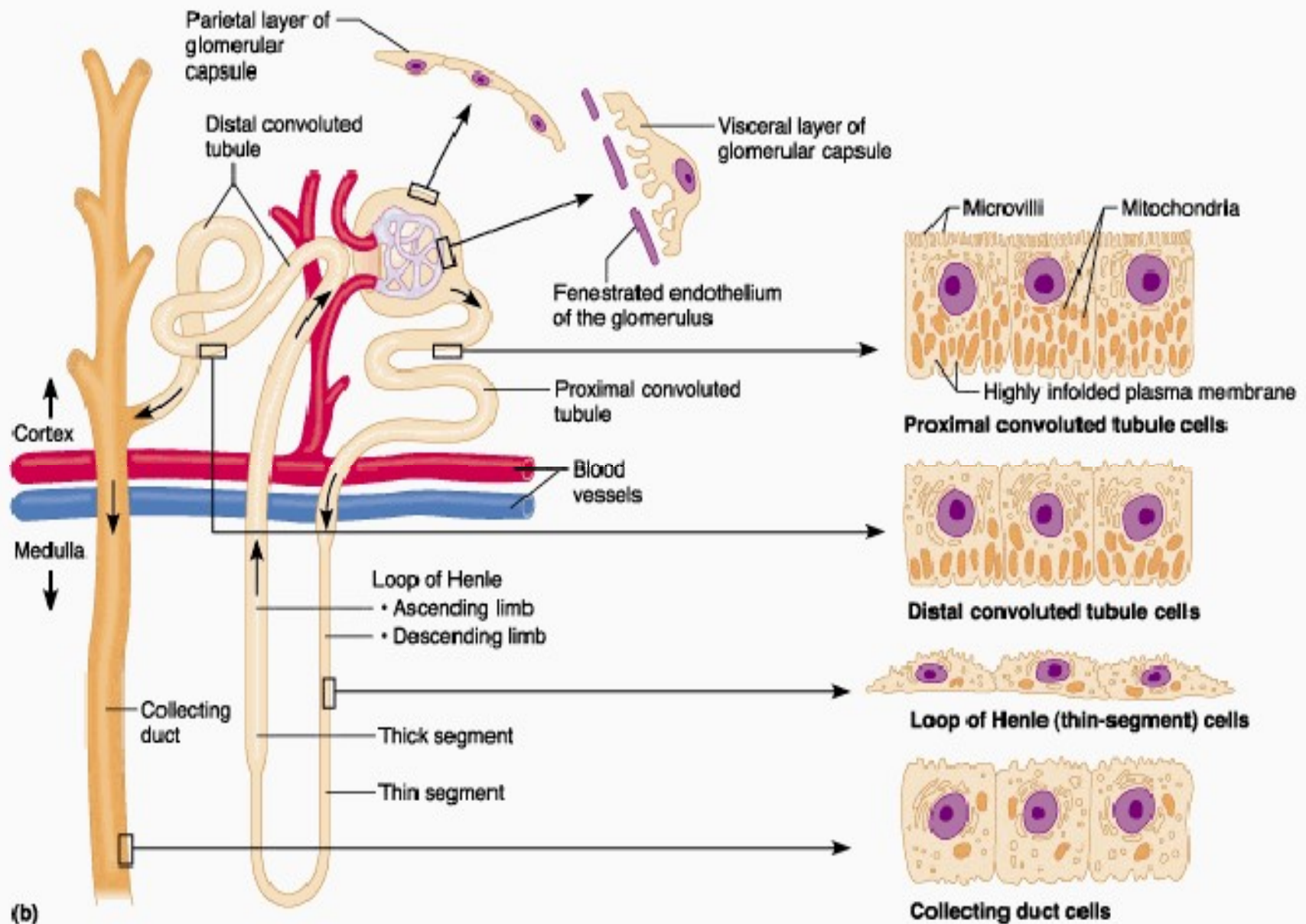
iv) Mesangial cells and matrix

- These are non-descript cells, found towards **vascular pole** of Glomerulus. These are of two types:-
 - a) **Lacis cells (Extraglomerular Mesangial cells):-** Found between the triangular space between afferent, efferent and macula densa. Found outside of glomerulus.
 - b) **Intraglomerular Mesangial cells:-** Found **within** the glomerulus. These cells produce matrix, which is extracellular material surrounding the Mesangial cells, it may contribute to maintenance of filtering membrane.

2. Renal tubules:-

➤ Renal tubules receive plasma filtrate from glomerulus and processes it into urine. It is composed of following parts:-

- A. Proximal convoluted tubule (p.c.t.)
- B. Loop of henle
- C. Distal Convoluted Tubule (D.C.T.)
- D. Collecting duct

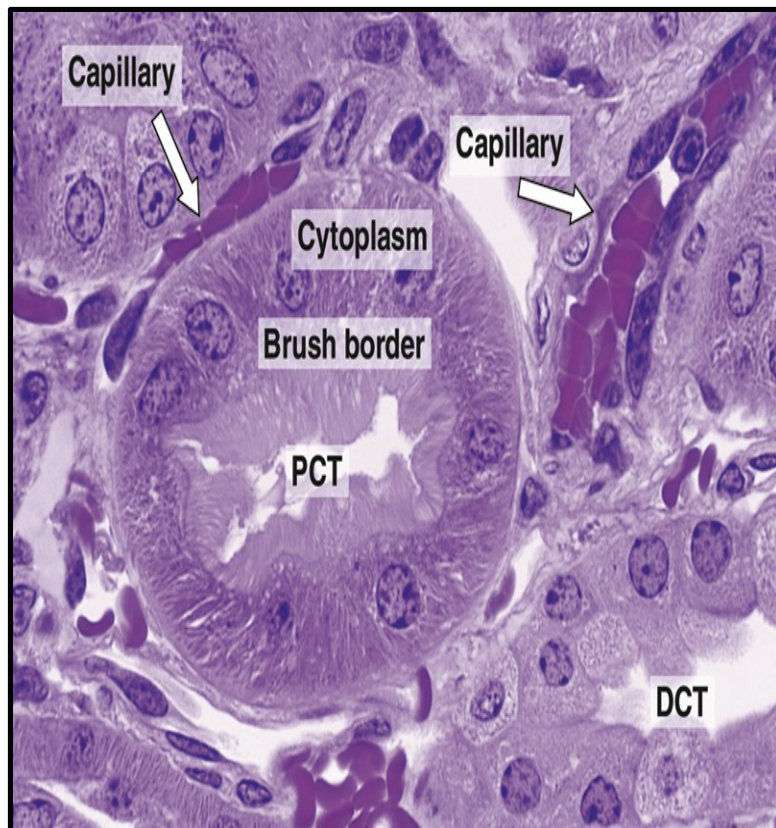


(b)

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A. Proximal convoluted tubule(p.c.t.)

- Proximal means **nearest** to the Renal corpuscle, convoluted means **Twists**.
- The **size of P.c.t. is much more than D.c.t.**, so it is common in histological slides than D.c.t.
- PCT lined by **simple cuboidal epithelium**, epical end of each cells has a **brush border** of microvilli, which increase surface area for absorption.



B. Loop of henle

- It present in renal medulla, Remarkable feature is water reabsorption. loop of henle is composed of 2 limb:-

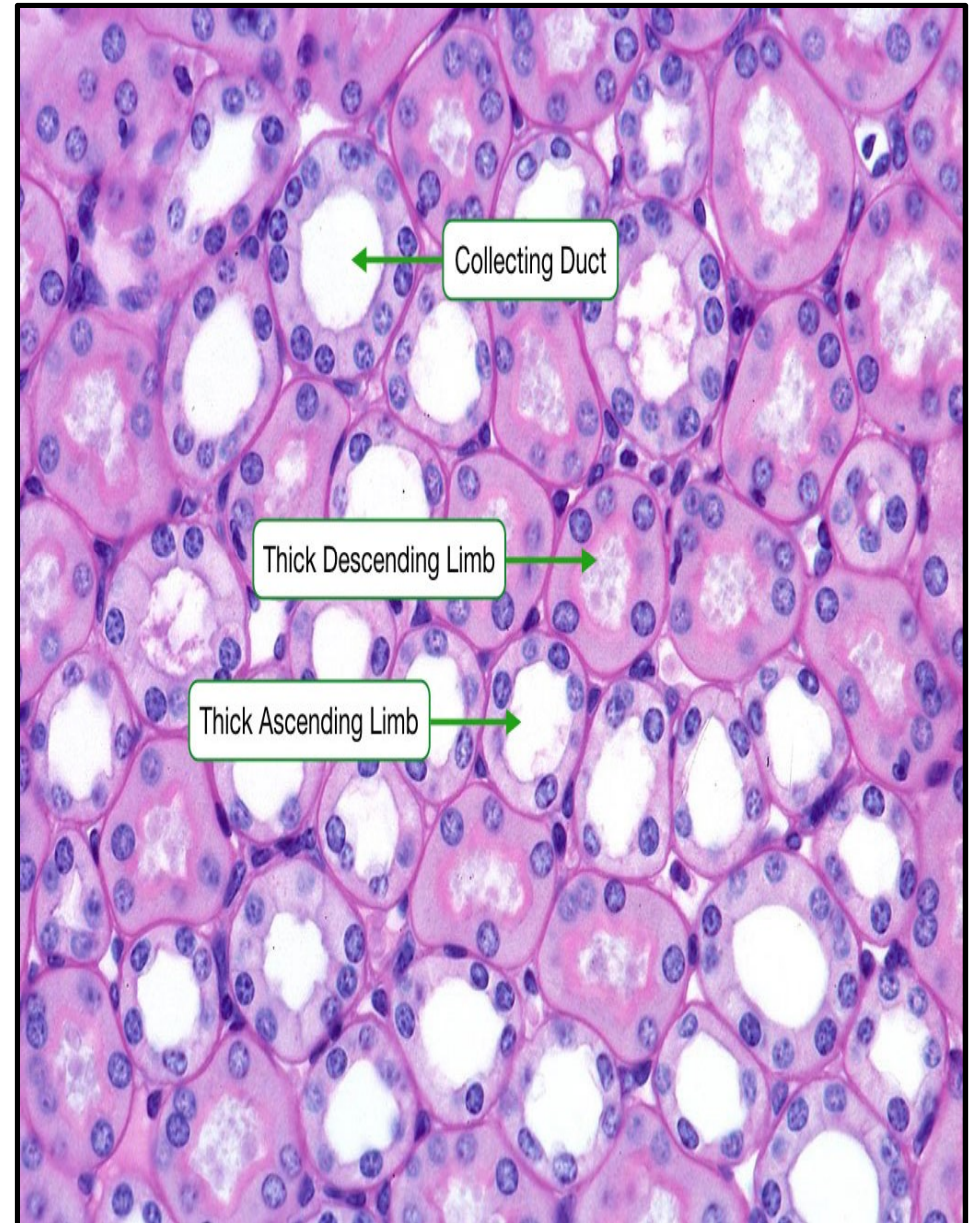
I. **Descending limb**:- 2 type segment

Present-

- Thick segment**:-It is initial, short and thick segment structurally similar to P.C.T. The segment of p.c.t. and thick segment of descending limb known as **PARS RECTA**.
- Thin segment**:- Lined by “**Simple squamous epithelium**”

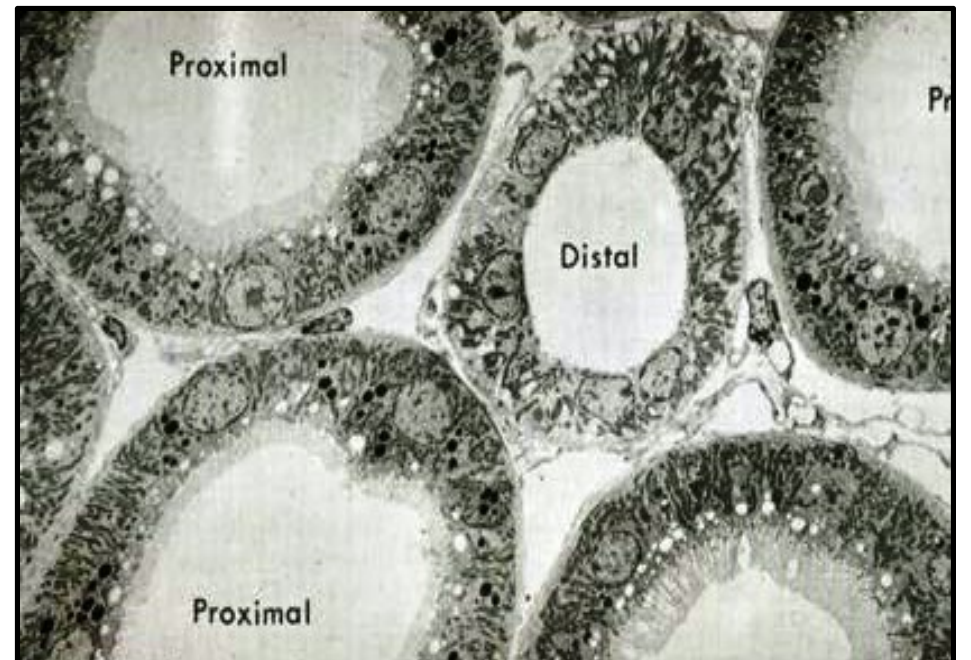
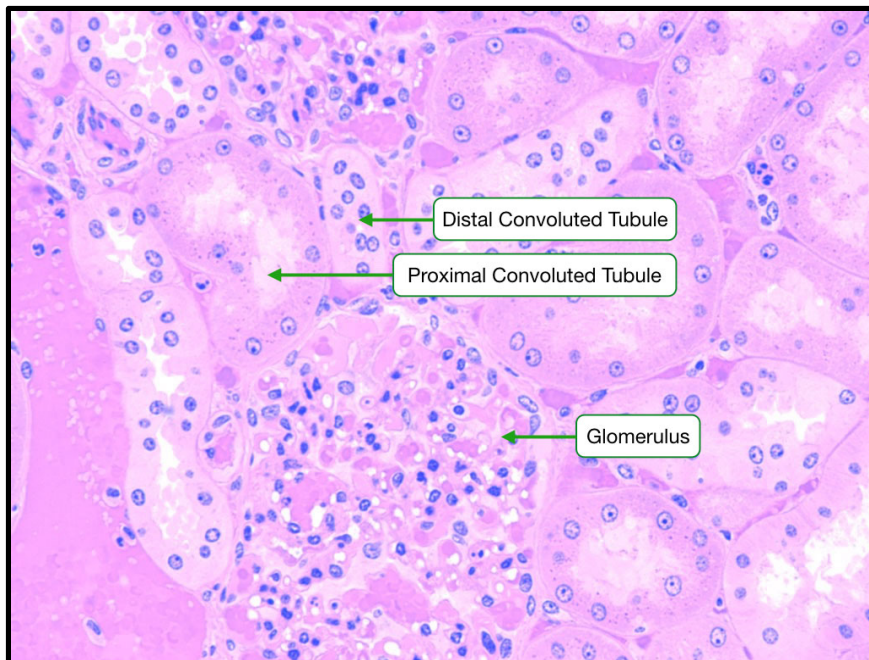
II. **Ascending limb**:- 2 type segment present

- Thin segment**:- Lined by **Simple squamous epithelium**.
- Thick segment**:- Lined by **Simple cuboidal epithelium**.



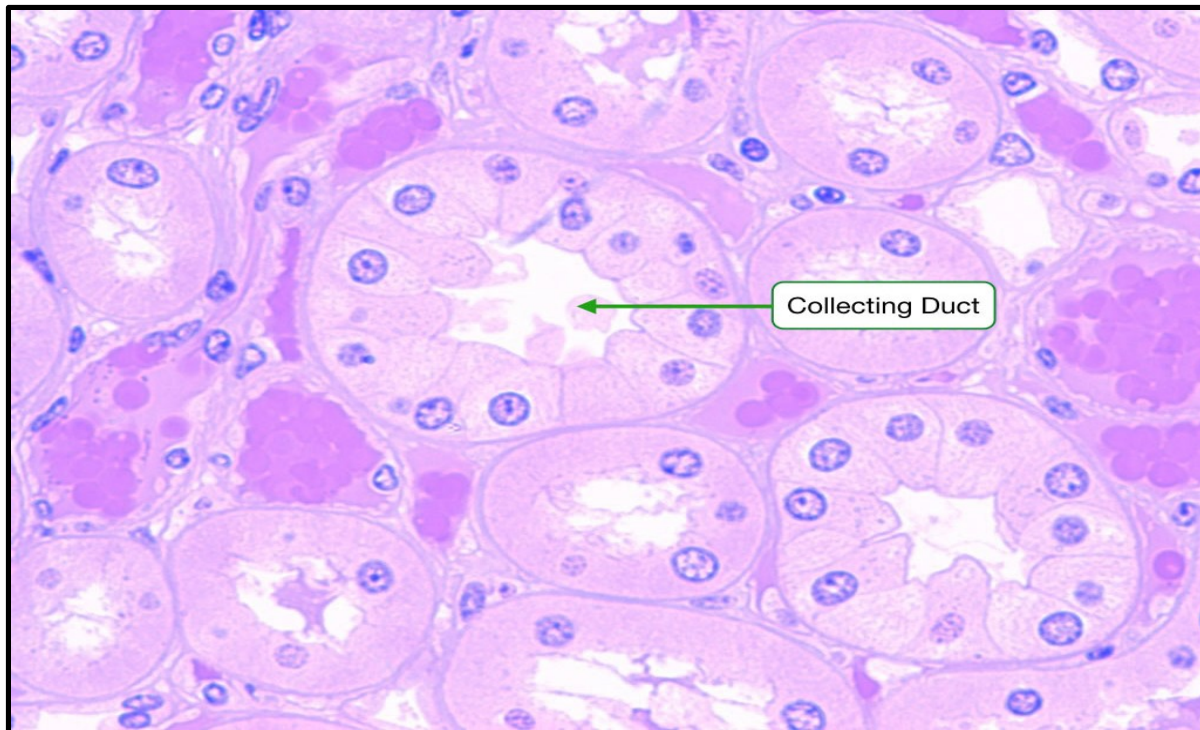
C. Distal Convoluted Tubule (D.C.T.)

- D.C.T. seen in cortex from ascending limb of henle. Each D.C.T. returns to the vascular pole of renal corpuscle, at this site D.C.T. come in a contact with afferent and efferent arteriole, and close clustering of epithelial nuclei in the wall of D.C.T. and form a structure **Macula densa**.
- D.C.T. lined by “**simple cuboidal epithelium**, **BRUSH BORDER** not present, but there may be **Scattered microvilli** present, because most of the heavily lifting work already done in P.C.T
- D.C.T. tends to be uncommon in histological slides because D.C.T. is shorter then P.C.T.



D. Collecting duct

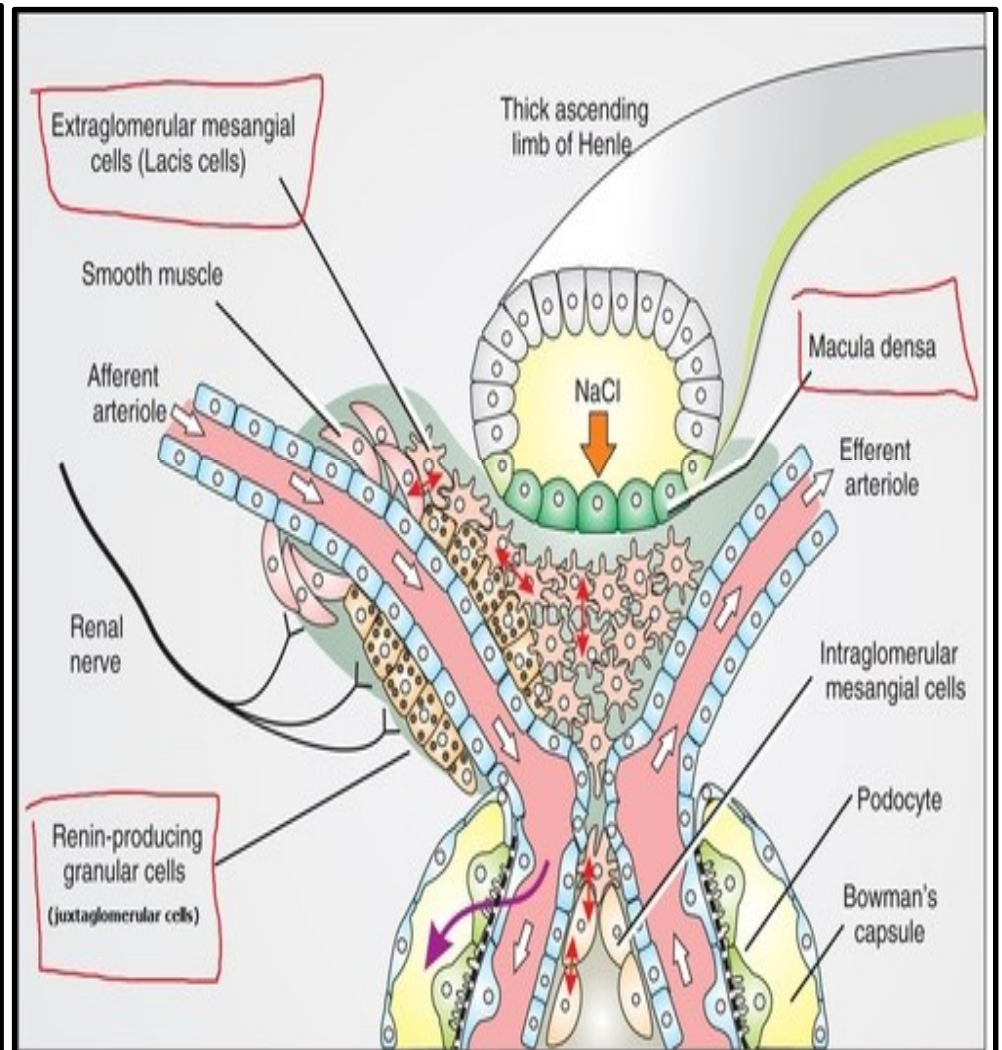
- It collect the urine from D.C.T., found in medulla, some in cortex.
- Clear cytoplasm and cell border usually distinct.
- Collecting duct smallest in cortex and largest in pelvis.



JUXTA-GLOMERULUS APPARATUS

➤ It is complex of structure associated with the vascular pole of renal corpuscle. It participate in the regulation of blood flow through glomerular capillary. It has 3 main components:-

1. Macula densa
2. juxta-glomerular cells(J.G. Cells)
3. Lacis cells

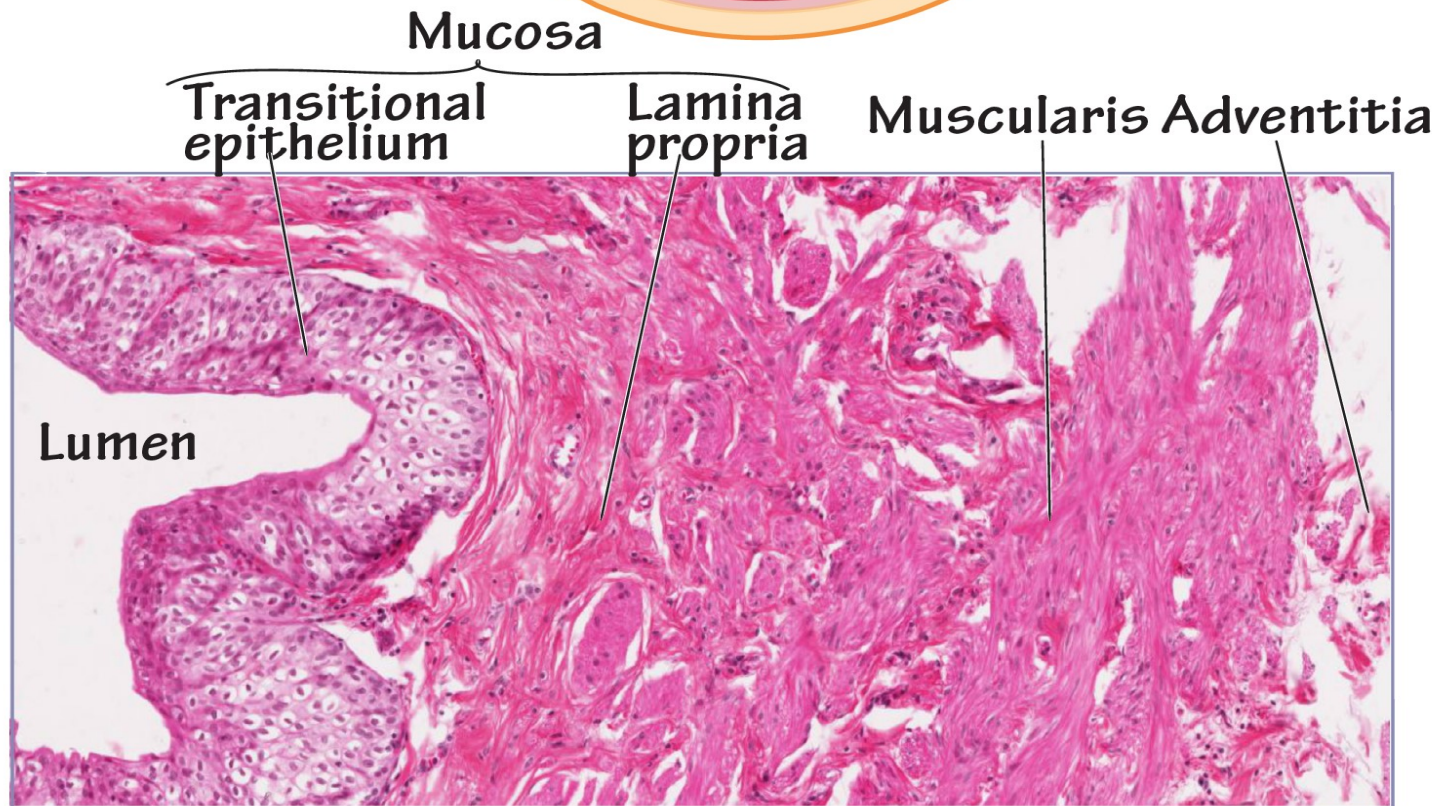
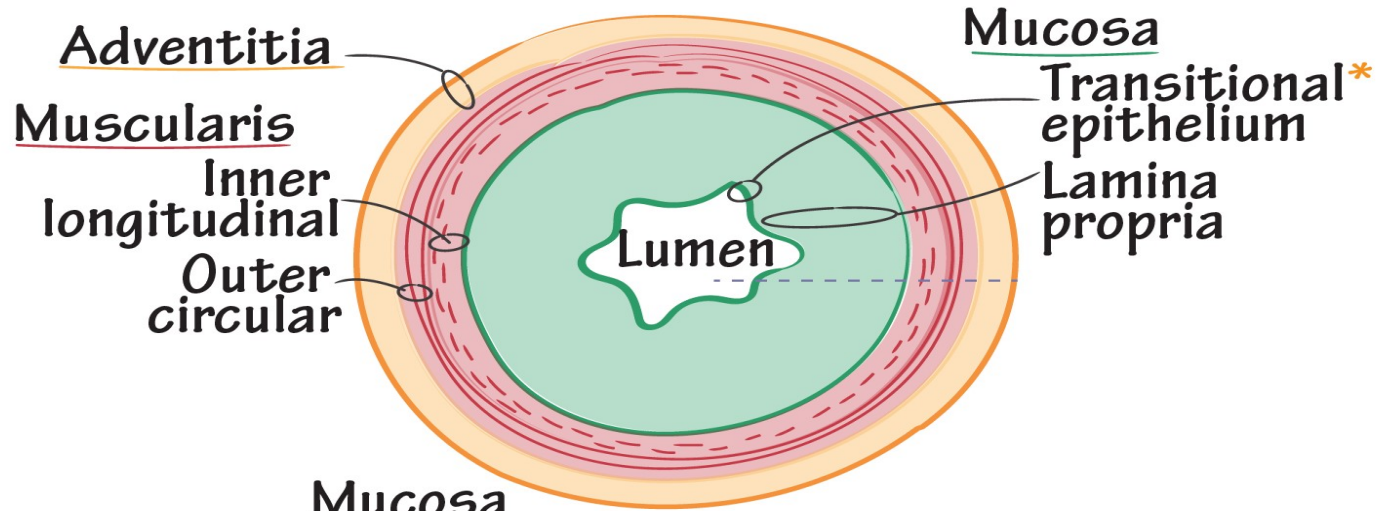


Ureters

The ureters carry urine from the kidneys to the bladder. The right ureter is slightly longer than the left because of the more cranial position of the right kidney.

The muscular wall of the ureter is divided into three thin layers: an outer longitudinal, a middle circular, and an inner longitudinal.

Ureter: Cross Section

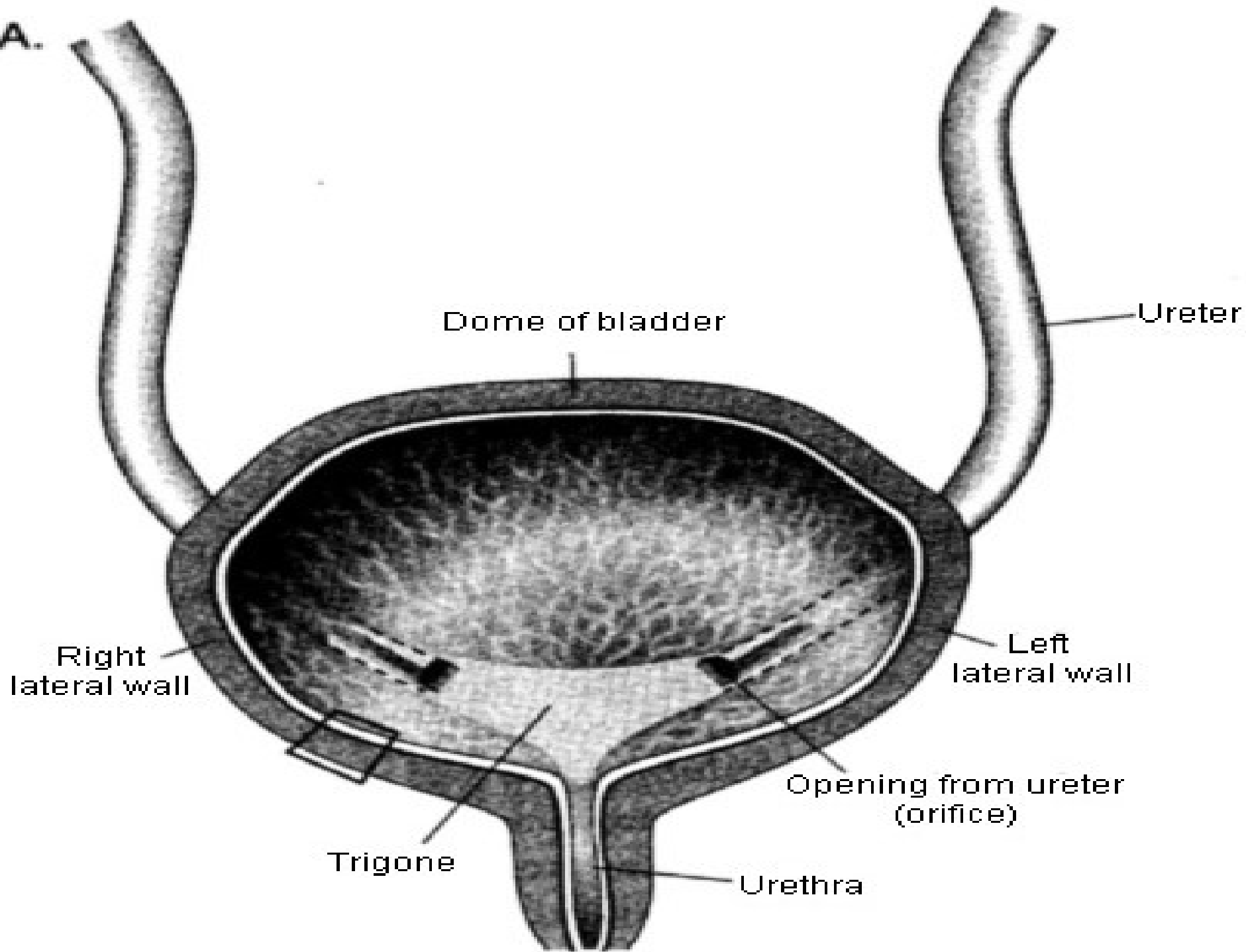


Urinary Bladder

The **urinary bladder** (*vesica urinaria*) is a hollow, musculomembranous organ that varies in form, size, and position, depending on the amount of urine it contains.

The bladder may be divided into a **neck** (*cervix vesicae*) connecting with the urethra, a **body** (*corpus vesicae*), and a blind cranial part, the **apex** (*apex vesicae*).

A.



Dome of bladder

Ureter

Right lateral wall

Left lateral wall

Trigone

Opening from ureter (orifice)

Urethra

Urinary bladder

- ▶ Epi: Transitional
- ▶ Lamina muscularis: present in horses, ruminants, pigs & dogs, however absent in cats
- ▶ Tunica Muscularis: three ill defined layers of smooth muscles
- ▶ Tunica serosa: outermost layer of connective tissue



<https://legacy.owensboro.kctcs.edu/lgcaplana/anat2/histology/histo%20E%20urinary%20system.htm>

Urethra

► Epithelium:

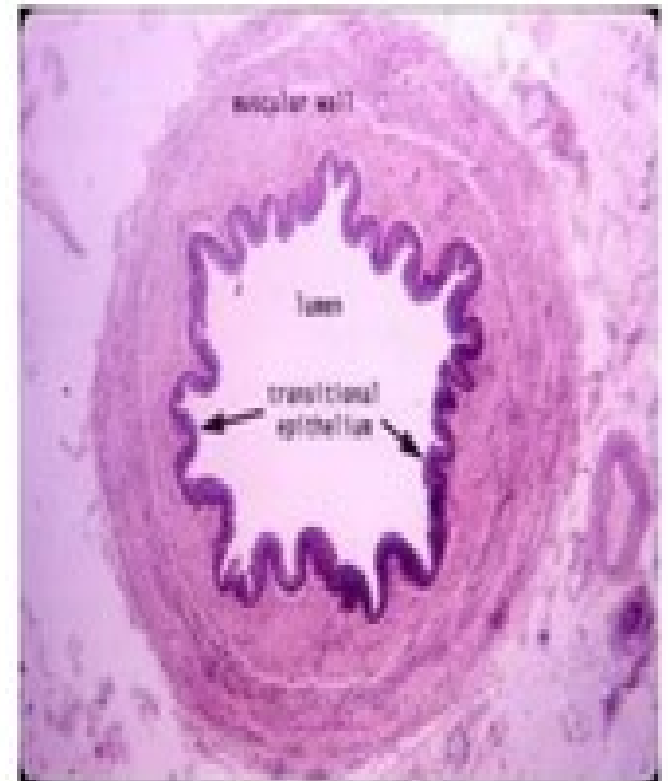
Transitional

OR

Membranous-pseudostratified columnar

OR

Spongy-pseudostratified + stratified squamous



<https://legacy.owensboro.kctcs.edu/igcaplan/anat2/histology/histo%20E%20urinary%20system.htm>

A white speech bubble sticker is pinned to a corkboard. The sticker has a soft, irregular shape with a small tail at the bottom. The text 'Thank you!!' is written in a bold, black, sans-serif font. The corkboard background is a warm, textured brown color.

Thank
you!!