Ministry of Higher Education
& Scientific Research
Al-Muthanna University
Faculty of Pharmacy

وزارة التعليم العالي والبحث العلمي
جامعة المثنى
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# First stage

## Faculty of Pharmacy

## Al-Muthanna University

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## Theory Histology

## Lec. (4)

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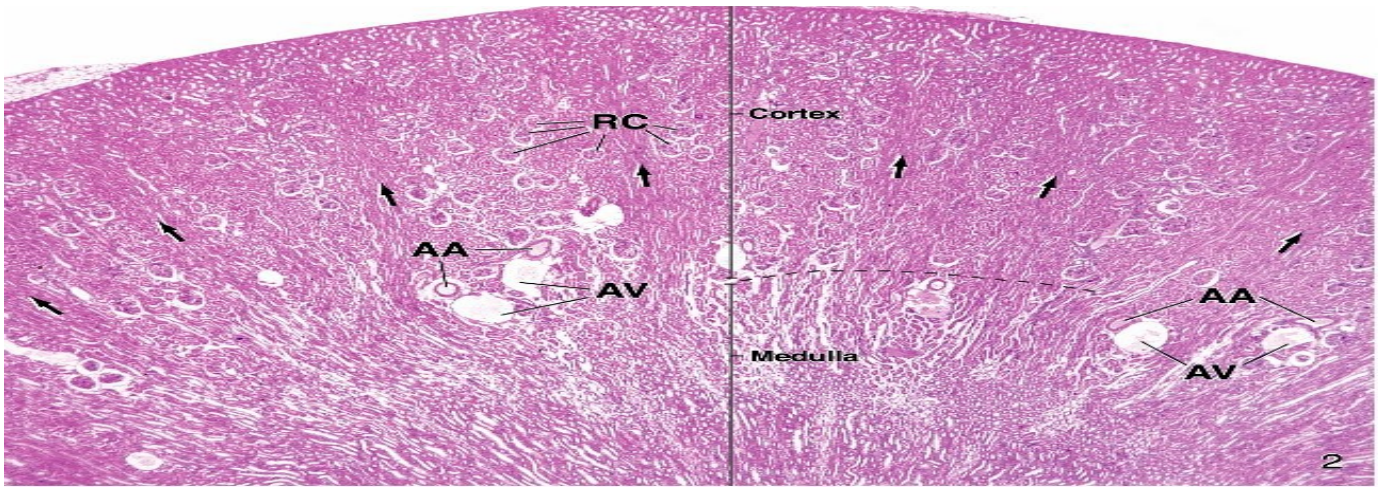
# URINARY SYSTEM

The urinary system consist of the following vital organs: ***Paired kidneys, Ureters, Unpaired bladder, Urethra.***

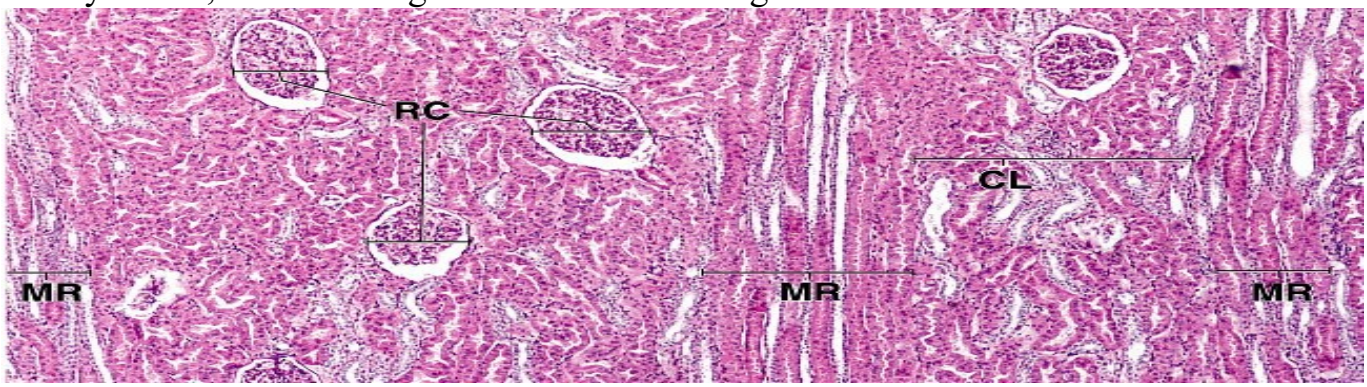
## General histological structure of the kidney

### The Capsule

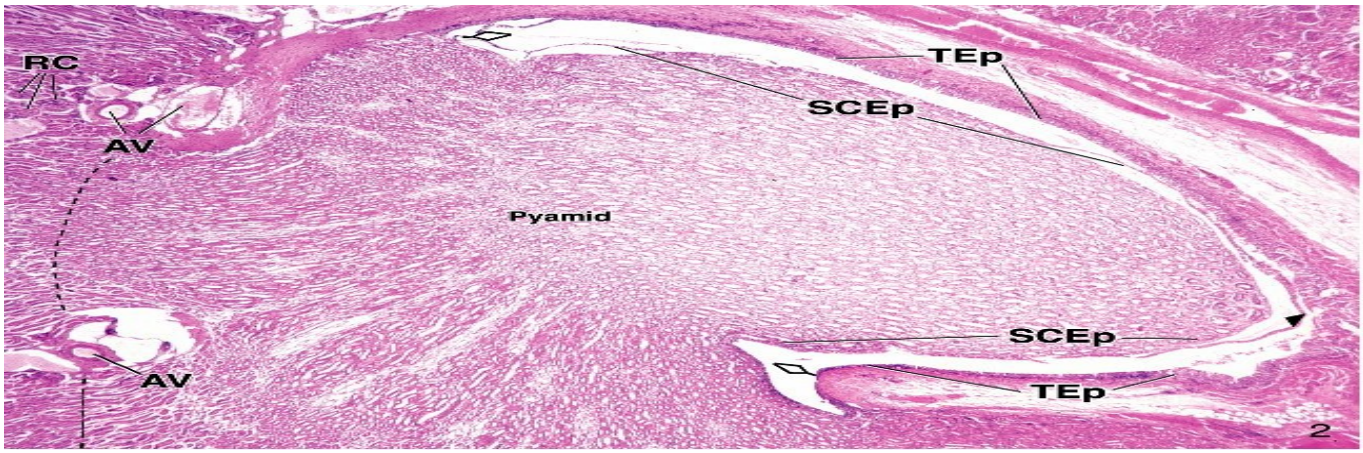
The kidney surface is covered by ***dense irregular collagenous connective tissue*** capsule. ***The kidney*** divided into: ***A-outer cortex region (darker) B-inner medulla region (lighter)***




**outer cortex region** (darker) which is subdivided into ***the cortical labyrinth*** which contain renal corpuscles, convoluted tubules of nephrons & collecting tubules & ***the medullary rays*** are parallel arrays of tubules, penetrate the cortex which form the core of a kidney lobule, contain straight tubules & collecting ducts .




**inner medulla region** (lighter) Which consist of 10-18 pyramidal structures known as ***medullary pyramids*** or ***renal pyramids*** constitute a lobe of kidney, from the base of each medullary pyramids, the round apex of each pyramid extends downward to the renal pelvis to form ***the renal papilla*** which surrounded by minor calyx. The region between neighboring renal pyramids is occupied by Cortical like material known as ***renal columns.***




## Uriniferous tubules

Its functional unite of each kidney, consisting of ***a nephron*** which represent the basic functional unit of the kidney, & ***collecting duct***.

### *The nephrons:*

the kidney is composed of 1-4 million nephrons ,each nephron is subdivided into two components :1-renal corpuscles 2-renal tubules

***The renal corpuscles*** are spherical structures about 200 µm in diameter & consists of a tuft of capillaries known as ***glomerulus***, surrounded by a double walled epithelial capsule called ***glomerular*** or ***Bowman's capsule***.

***The internal layer: the visceral layer*** of the capsule consisting modified branching epithelial cells called ***Podocytes*** which have several primary processes which gives rise to numerous secondary processes, called ***pedicels*** that embrace the capillaries of the glomerulus & contain elongated spaces known as ***the filtration slits.***

***The external layer*: *the parietal layer*** of Bowman's capsule forms the outer limit of the renal corpuscle, these layer consists of ***simple squamous epithelium*** supported by a basal lamina & a thin layer of reticular fibers & change to the ***simple cuboidal*** characterize of the proximal tubule.

***The urinary space*** between the two layers of Bowman's capsule, which receives the fluid filtered through the capillary wall & the visceral layer

**The renal corpuscle** has ***a vascular pole*** , characterized by ***afferent arteriole*** enters & the ***efferent arteriole*** leaves , and on opposite end of the renal corpuscle ***a urinary pole***, where ***the proximal convoluted tubule*** begins. The afferent arteriole after entering the renal corpuscle, usually divided in to 2 -5 primary branches, each subdividing in to capillaries & forming ***the renal glomerulus*** .

***Filtration apparatus of the kidney consisting of three components are:***

- Endothelium of the glomerular capillaries.
- Glomerular basement membrane (GBM).
- Visceral epithelial cells.

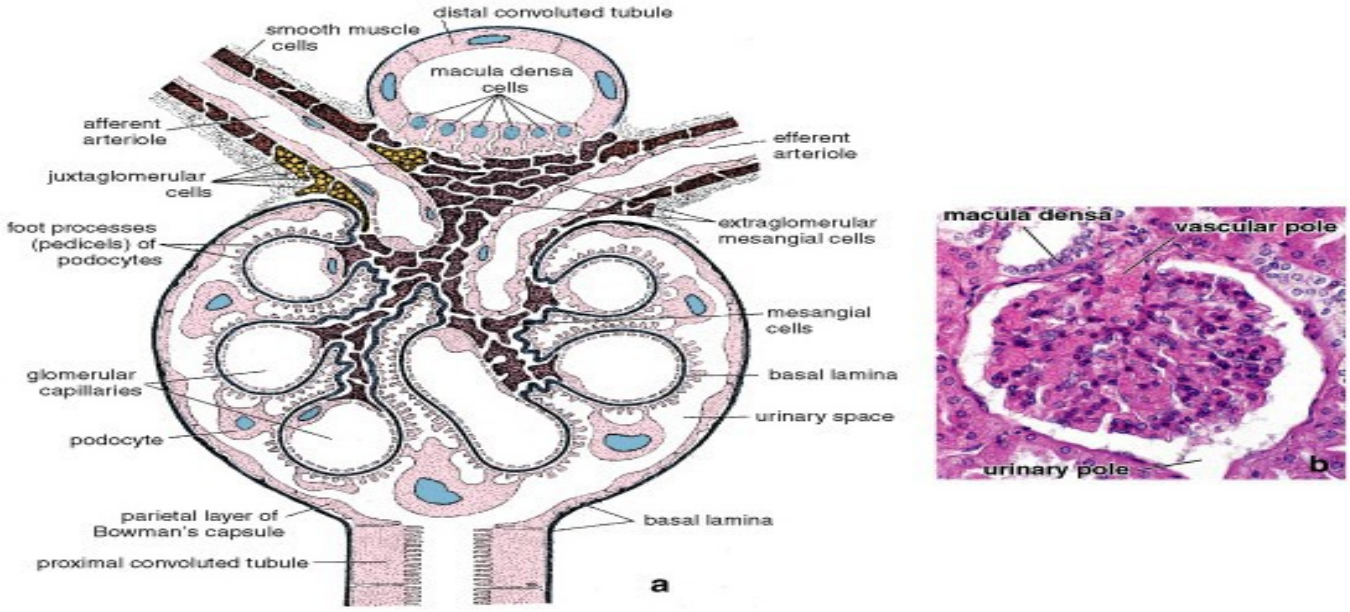



Figure 19.7. **Diagram and photomicrograph (x160) of the renal corpuscle.**

**types of nephrons :**

Types of nephrons are identified, based on the location of their renal corpuscles in the cortex .

- Juxtamedullary nephrons
- Cortical nephrons:

**Proximal Convoluted Tubule (P.C.T.)**

It is found in the ***renal cortex*** near the renal corpuscles & receives the ultrafiltrate from the urinary space of Bowman's capsule .at the ***urinary pole*** of the renal corpuscles, the squamous epithelial of the parietal layer of Bowman's capsule is changed to the ***cuboidal epithelium*** of the proximal convoluted tubule, these tubules are ***longer*** & ***slightly larger outside diameter*** than distal convoluted tubule & the proximal convoluted tubules has a ***wide*** lumen is ***often star shape,*** contains ***3-5 spherical nuclei*** & ***large cell,*** has abundant microvilli in the apex which form ***a brush border.***

**Henle's Loop**

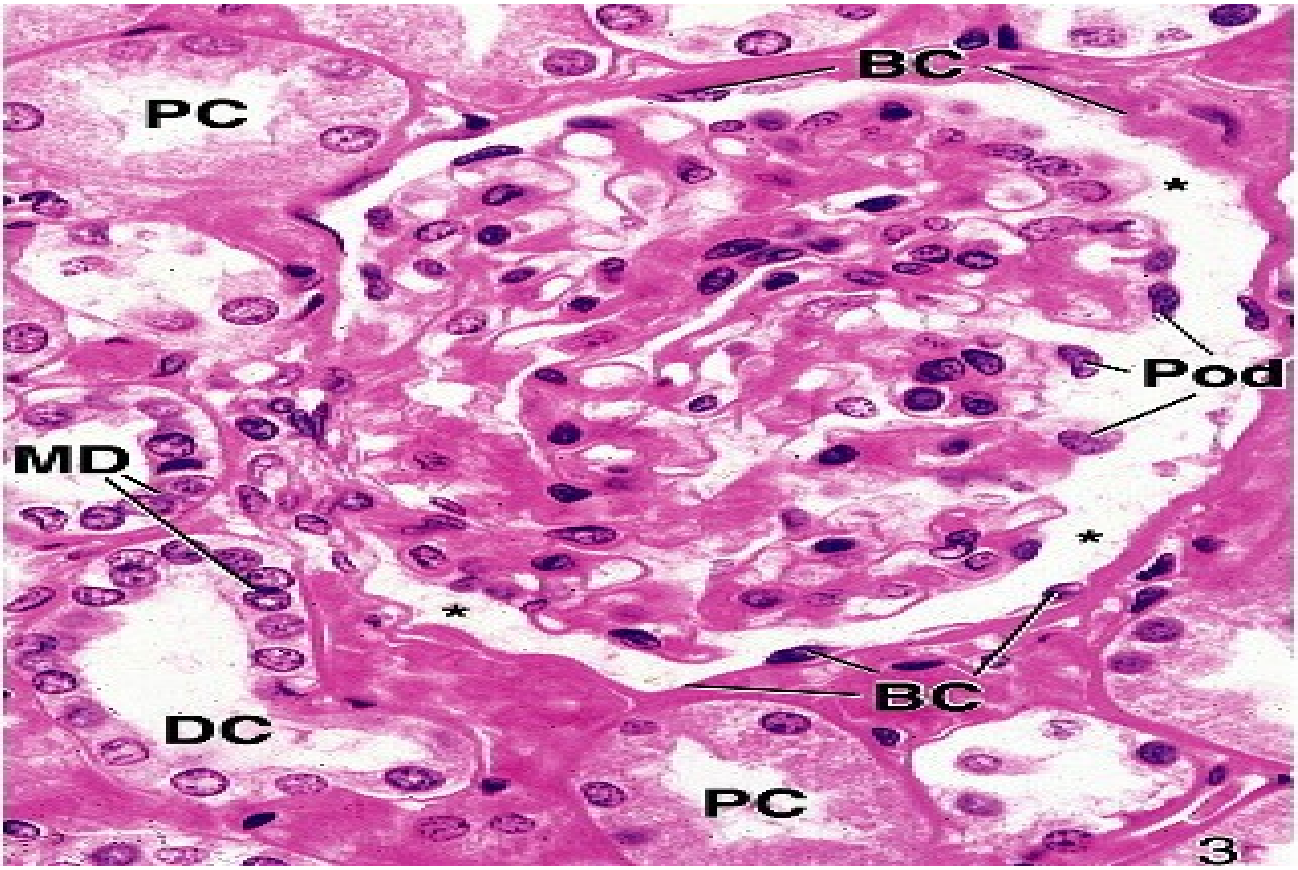
It's a U-shaped structure consisting of a ***thick descending & ascending segment*** has narrow lumen lined by simple cuboidal epithelium , and ***thin descending segment & ascending segment***, the lumen of this segment is ***wide*** lined by simple squamous epithelial cells.

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

The thick ascending segment of the Henles loop is straight enters the cortex and become tortuous as the D.C.T. is lined with ***simple cuboidal epithelium.***

The distal convoluted tubule differ from the proximal convoluted tubule because they have ***no brush border*** , ***no apical canaliculi*** , and ***smaller cells*** , because distal tubule cells are flatter & smaller than those of the proximal tubule , ***more nuclei*** are seen in the distal tubule than in the proximal tubule.

The D.C.T establishes contact with the vascular pole of the renal corpuscle of its parent nephron, at this point of close contact, the distal tubule is modified as is the afferent arteriole, the cells of the distal convoluted tubule usually become ***columnar*** in the juxtaglomerular region & their nuclei are closely packed together.
this modified segment of the wall of distal tubule is called the ***macula densa***. the cells of the macula dense are sensitive to the ionic content & water volume of the tubular fluid, producing molecular signals that promote the liberation of the enzyme renin in the circulation.




## *Collecting tubules and ducts*

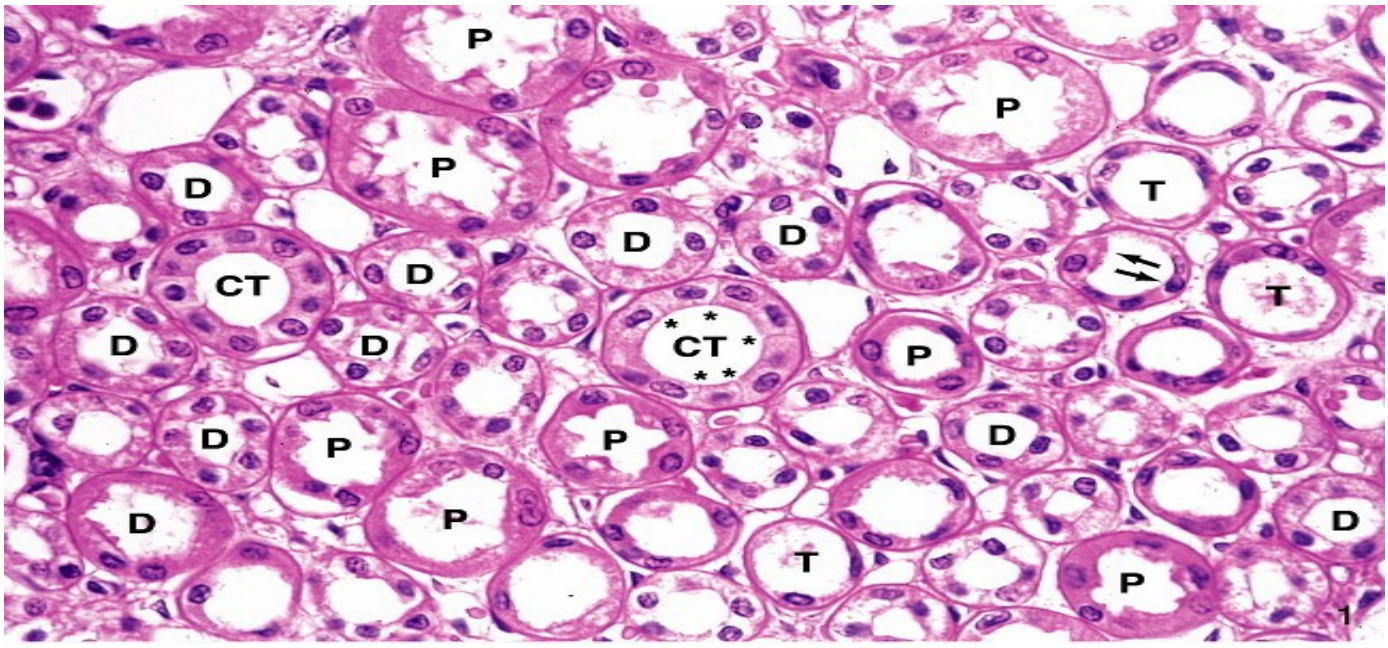
Urine passes from D.C.T. to collecting tubules that join each other to form larger, straight ***Collecting ducts*** (Bellini ducts) that run to the tips of the medullary pyramids and empty into the minor calyces by ***papillary duct*** .

 The smaller collecting tubules are lined with ***cuboidal epithelium*** and become ***columnar epithelium*** in the region of renal papilla.

 The Collecting tubules and ducts are composed of two types of cells

***1. Light cells or principal cells***

***2. Intercalated cells (dark cells)***




**Bladder and urinary passages :**

**1- Ureter :**

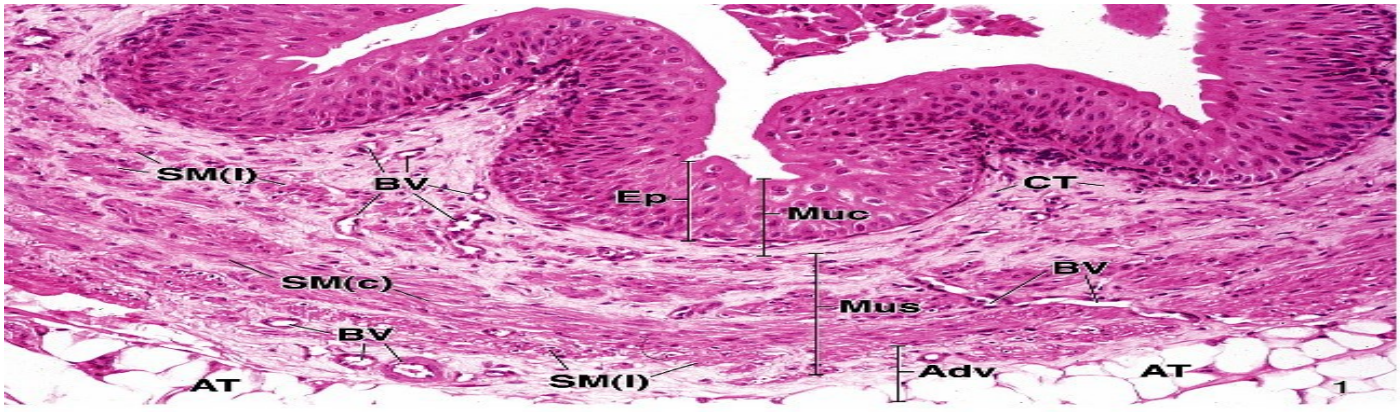
The ureter is a muscular tube possesses a **stellate – shaped** lumen that conveys urine from the kidneys to the bladder by the contractions of the thick smooth muscle layers found in the wall.

- the mucosa is highly folded lined by a ***transitional epithelium***(urothelium) has several cell layers.

- ***A thin basement membrane*** separates epithelium from lamina propria which composed of a ***fibroelastic connective tissue*** which is ***denser*** with more fibroblasts under the epithelium and ***looser*** near the muscularis.

- ***The muscularis*** composed of ***inner longitudinal*** smooth muscle layer and a ***outer circular*** smooth muscle layer and in lower portion when the ureter pass near the bladder a third ***outer longitudinal*** smooth muscle layer is present.

-***The adventitia*** is a fibro-elastic connective tissue.



**2- pelvis :**

The renal pelvis, subdivided into the miner and major calyces constitutes beginning the main excretory duct of the kidney.

- the renal pelvis lined by ***transitional epithelium (urothelium)*** which is reflected onto renal papilla in miner calyces .
- the subepithelial connective tissue of both loosely arranged and abuts the muscularis composed of ***inner longitudinal*** and ***outer circular*** layers of smooth muscle.
- ***adventitia*** of loose connective tissue surrounds the muscularis .

**3- Urinary bladder :**

It is a hollow organ with a thick muscular wall, resembles the ureter except that it is a larger structure & does not possess a stellate lumen, which main functions is to store urine.

***The mucosa*** of an empty bladder exhibits numerous ***mucosal folds*** that disappear during bladder distension & lined by ***transitional epithelium (urothelium)***.

***Lamina propria***, which is a ***fibroelastic*** connective tissue & may contain occasional ***mucus glands*** at the internal orifice of urethra.

***The muscularis*** run in every direction without distinct layers until approach the bladder neck where there distinct three layers composed of an ***inner longitudinal, middle circular*** and ***outer longitudinal*** smooth muscle layer, ***the middle circular layer*** forms the internal sphincter at the neck of the bladder.

***adventitial*** covering the urinary bladder except upper part which covering by serosa .

**4- Urethra**

It is a fibromuscular tube that conveys urine from the urinary bladder to the exterior through the external urethral orifice.