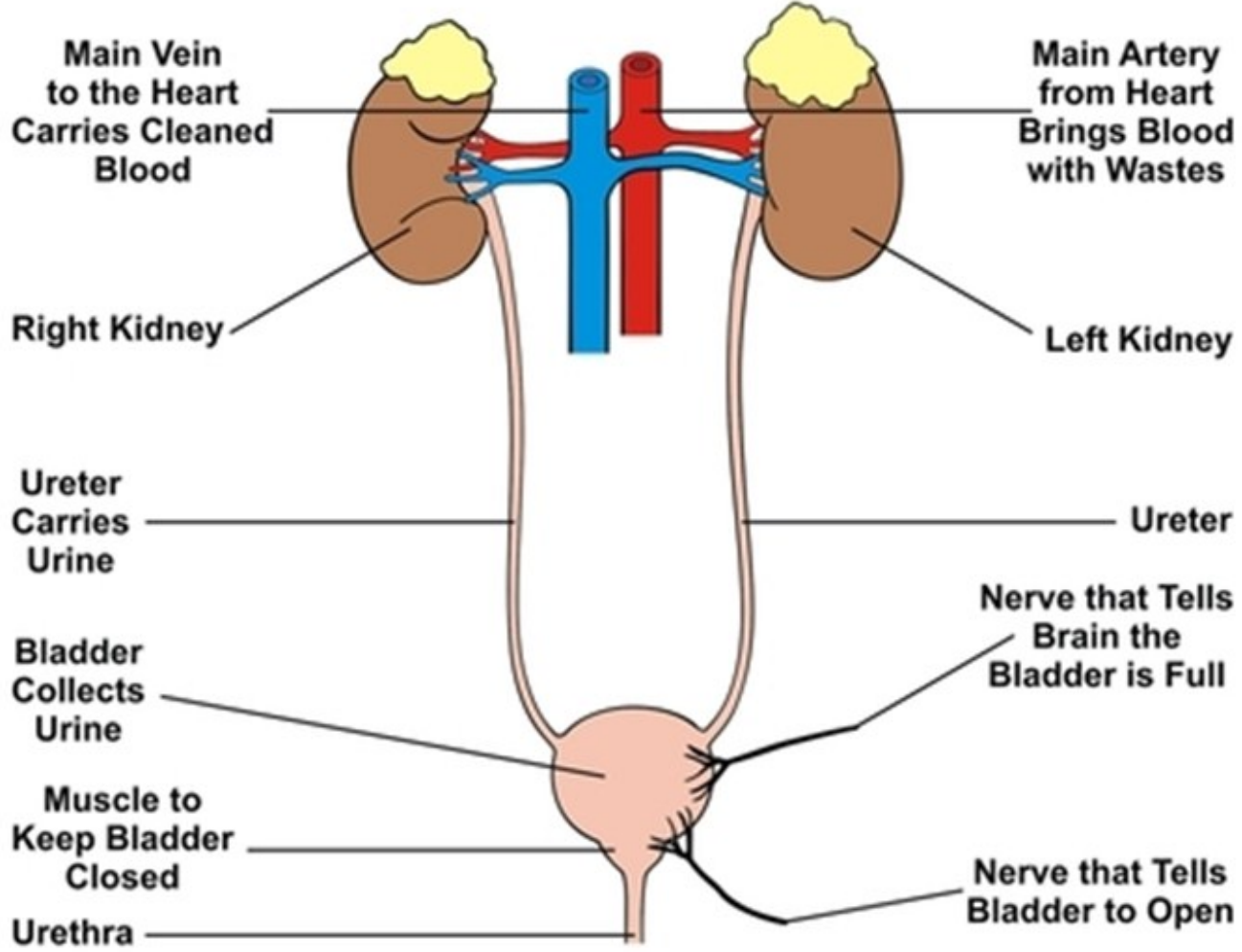


LECTURE 4b

URINARY SYSTEM

(DR. B.M. KAVOI)

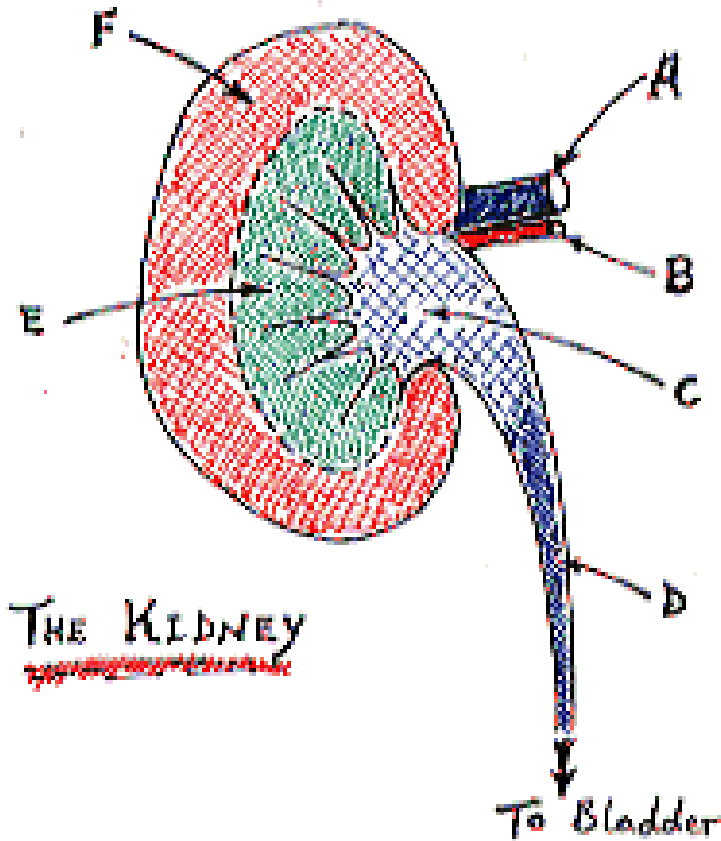
URINARY SYSTEM



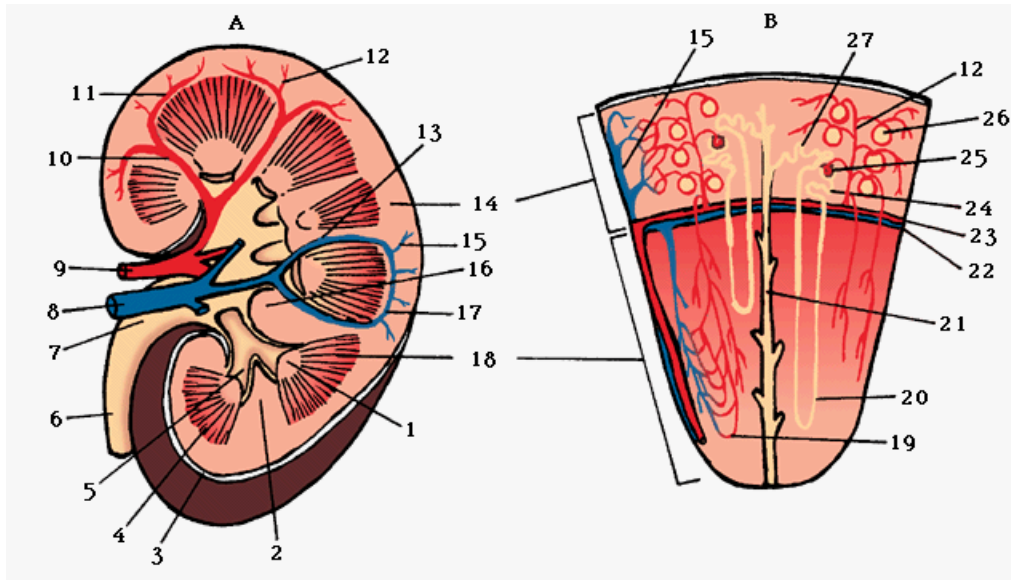
- Main components of this system- 1. Kidneys, 2. Ureter, 3. Urinary bladder and 4. Urethra

1. KIDNEY

- Parenchyma organized into **cortex** (F) and **medulla** (E)
- Within parenchyma occur **nephrons**, **collecting ducts**, **blood vessels**, **lymphatics** and **nerves**
- Parenchyma organized into **lobes** and **lobules**



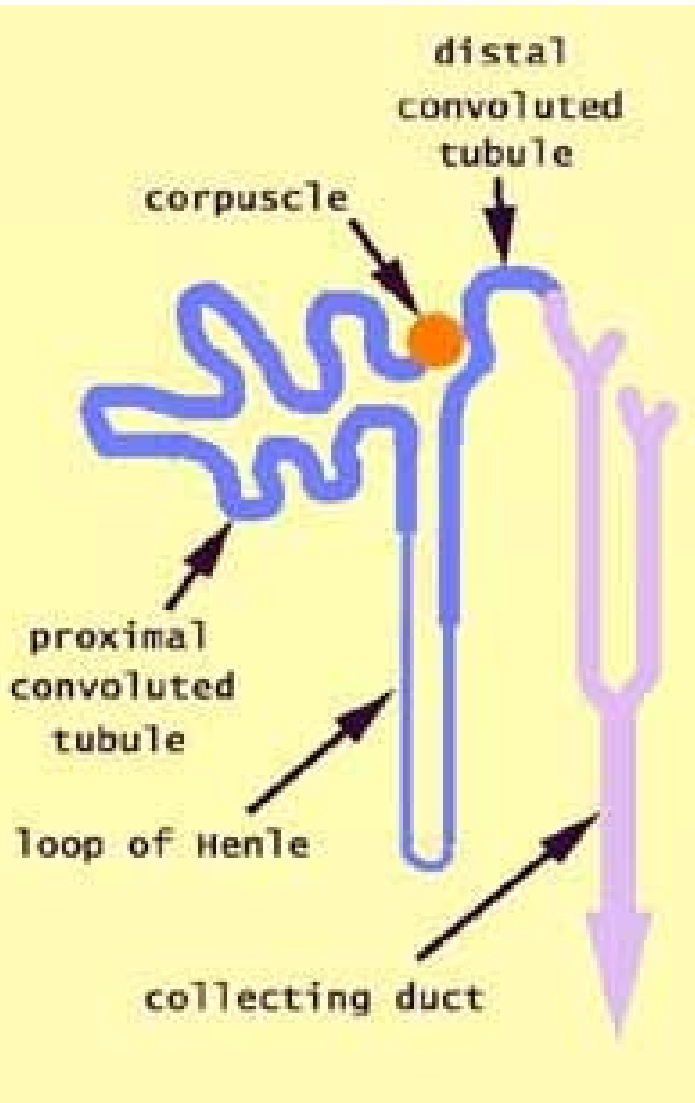
Lobes and lobules



- **Lobes** are located btw adjacent renal columns with peripheral limits within medulla being the interlobar arteries
- A renal **lobule** is defined as a portion of the kidney containing those nephrons that are drained by a common collecting duct.

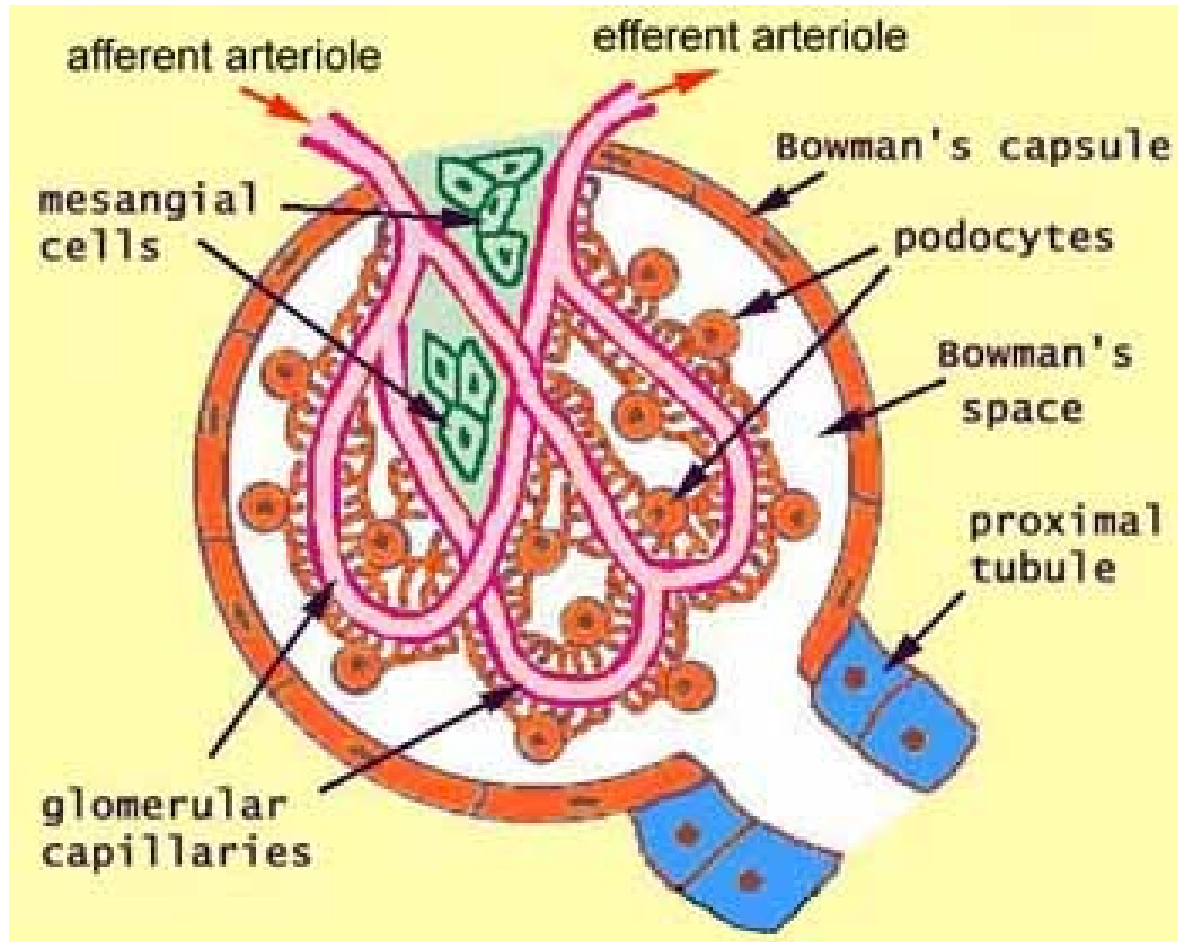
- At the cortex, the collecting duct lies at the axis of lobule, being surrounded by corticolabyrinth or network comprising of renal corpuscles, PCT and DCT
- **Lobules** are centered on "medullary rays", which are bundles of straight tubules (collecting ducts and loops of Henle)
- Within the cortex, peripheral limits of a lobule are the interlobular blood vessels while in medulla, limits of lobules are not defined

Nephron

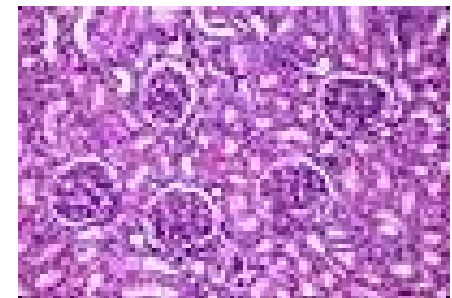


- Tubules in which urine is formed (functional unit of the kidney)
- Form the most abundant tissue of renal parenchyma
- Consist of 5 parts;
 - i. Renal corpuscle,
 - ii. Proximal convoluted tubule
 - iii. Medullary loop (loop of Henle)
 - iv. Distal convoluted tubule
 - v. Collecting duct

i. Renal corpuscle



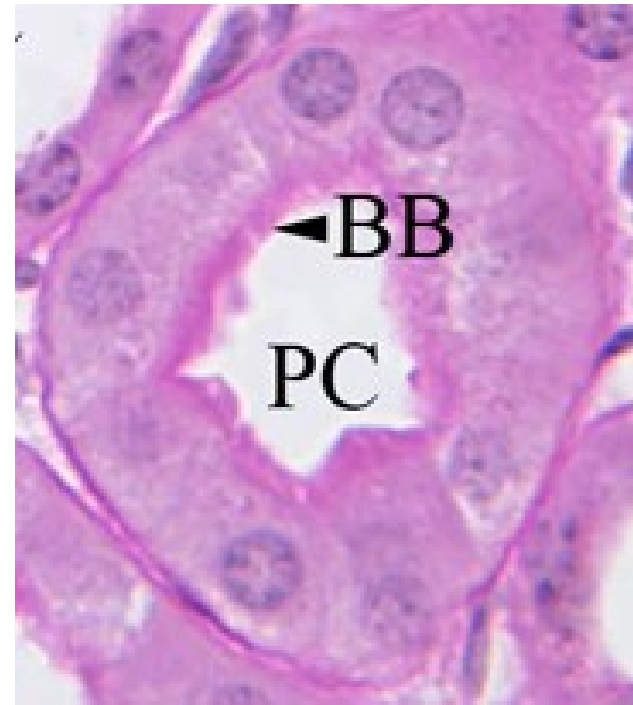
- Produces glomerular ultrafiltrate
- Is a spherical structure comprising of
 - a) cluster of blood vessels= **glomerulus**
 - b) double walled envelope= glomerular or **Bowman's capsule**



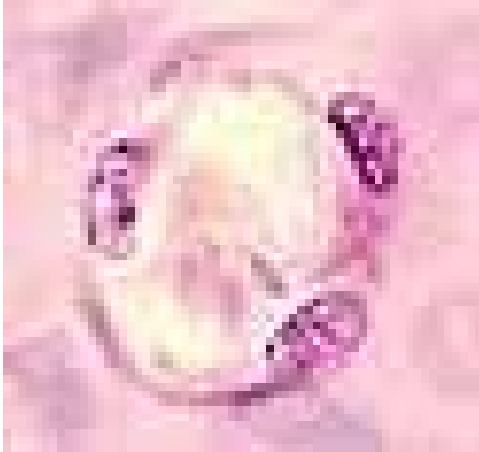
- Efferent arterioles enter while the afferent arterioles leave the glomerulus at **vascular pole** while ultrafiltrate leave corpuscle at **renal pole**
- Capillaries forming glomerulus are **fenestrated** and their endothelium rests on a thick basal lamina
- Bowman's capsule comprise of **inner visceral** and **outer parietal layers** and Bowmans space in btw the layers
- Parietal layer is formed by **simple squamous cells** while visceral is formed by **podocytes**, whose foot processes (pedicels) contact glomerular blood capillaries
- The connective tissue stroma of the glomerulus is constituted by **mesangial cells**, which support the glomerular capillaries

ii. Proximal convoluted tubule

- Reabsorption of water, nutrients and solids (obligatory)
- Lined by simple cuboidal epithelium resting on a thin b. lamina
- Tubule cells have microvilli on their luminal surfaces (typical brush border)
- Tubule cells appear striated due to numerous basal infoldings & plenty of mitochondria



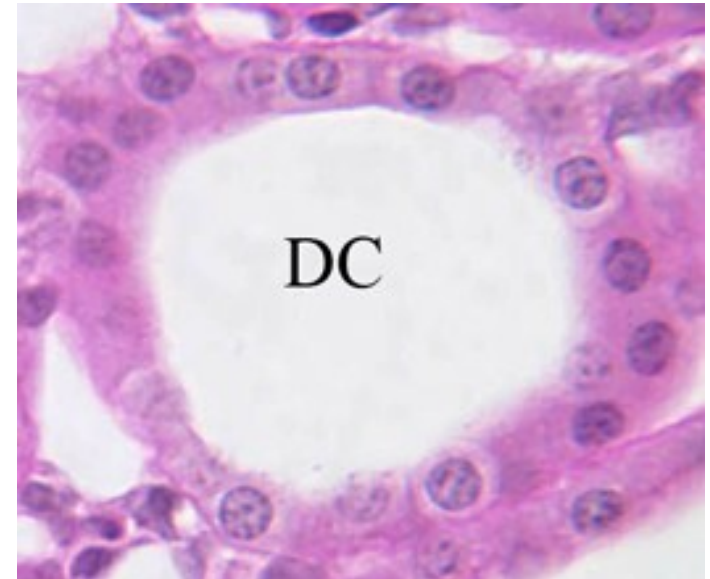
iii. Medullary loop



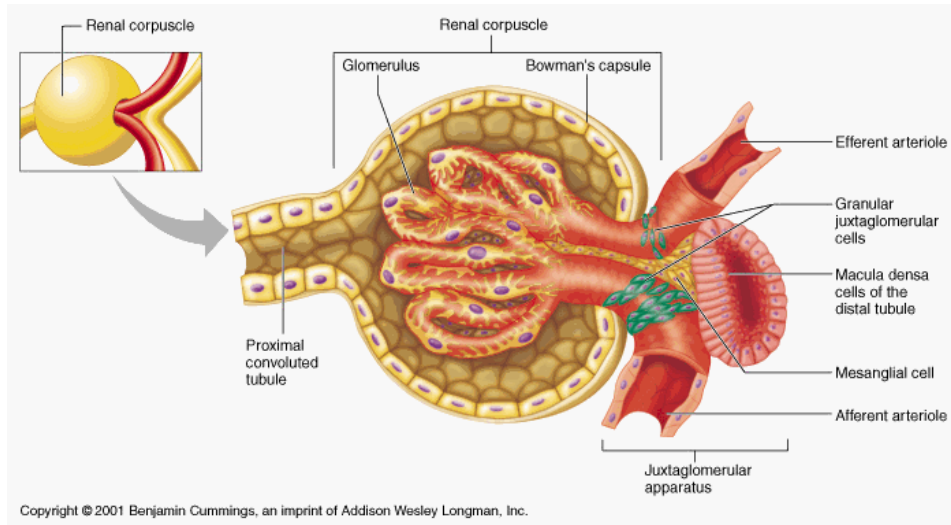
- Functions as a **counter-current multiplier system** to determine osmolarity of urine; blood flow in the loop is counter to that in medullary vasa recta.
- Extends from corticomedullary junction to medulla
- Consists of an **descending limb**, a **thin segment** and a **ascending limb**
- The thin part is lined by **simple squamous epithelium** resting on a thin BL; the sq cells bulge into the lumen of tubule

iv. Distal convoluted tubule

- Reabsorbs most of substances contained in ultrafiltrate especially glucosa and amino acids (mainly facultative)
- Reabsorption regulated by ADH and aldosterone
- Continues from the m. loop and extends to collecting tubule within cortex
- Lined by low simple cuboidal epithelium resting on a thin BL
- The cells lack microvilli but are striated, with basal infoldings and but less mitochondria
- Its epithelial cells stain less osmophilic compared to those of PCT



Juxtaglomerular apparatus



- Formed where the **DCT** contacts the afferent arteriole of parent r. corpuscle
- Constituted by 3 cell types;
 - i. **macular densa cells of DCT** (t. cells that become columnar & closely packed)
 - ii. **Juxtaglomerular cells of afferent arteriole** (smooth muscle cells of tunica media that become spherical and contain renin granules)
 - iii. **Extraglomerular mesangial cells** (similar to those within glomerulus and surrounded by thick BL)
- **Produce renin** which converts angiotensinogen to angiotensin, (a vasoconstrictor which raises bld pressure thus flow of ultrafiltrate)

v. Collecting tubule

- Drain urine from nephron to renal pelvis
- Lie on medullary ray within cortex
- Progressively increase in diameter towards medullar
- In inner medullar, CD from different renal lobes unite to form large papillary ducts, which open into renal pelvis

- Drain urine from nephron to r. pelvis
- Progressively increase in diameter towards medullar
- In inner medullar, unite with other CDs to form large papillary ducts, which open into renal pelvis
- CD are lined by epithelium that has 2 cell types
 1. collecting duct cells – cuboidal in cortical part, columnar in medullary
 2. intercalated /dark cells- resemble those of DCT but bulge into lumen of the CD
- Both cell types rest on a thin BM and lack basal infoldings
- Permeability of CD to water and ions is regulated by ADH



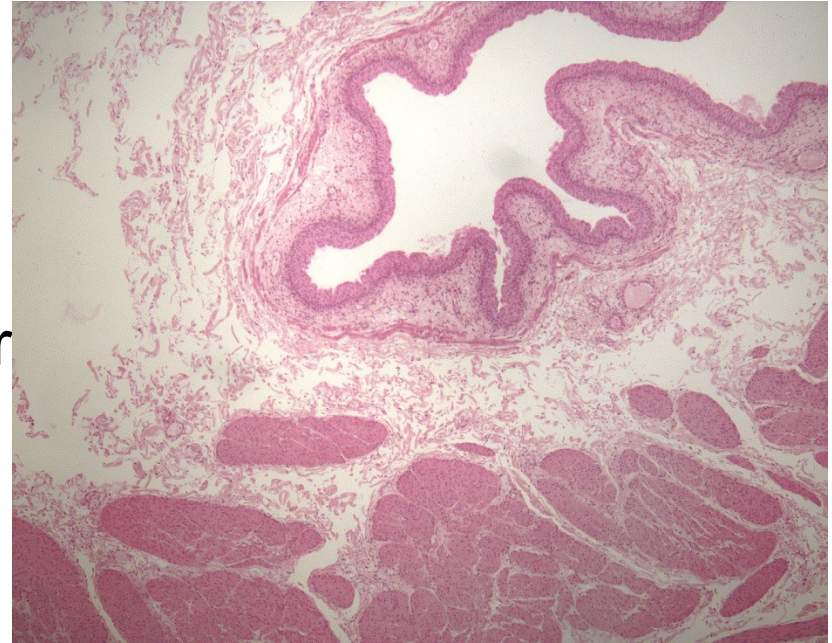
URETER



- Conducts urine from kidney to bladder
- Has 3 tissue layers
 1. Tunica mucosa; lined by 5-6 cell layer of transitional epith that rests on lamina propria of loose c. tissue having bld vessels, lymphatics and with tubular mucus glands in the equidae
 2. T. muscularis; has inner and outer longitudinal and middle layer of smooth muscles
 3. T. serosa/ adventitia

Urinary bladder

- Its wall has 4 tissue layers;-
 1. Tunica mucosa; lined by up to 14 cell layers of transitional epith that rests on lamina propria of loose c. tissue
 2. T. submucosa; highly vascular and rich in elastic fibers
 3. T. muscularis; has inner and outer longitudinal and middle layer of smooth muscles (detrusor muscles)
 4. T. serosa/ adventitia
- The longi muscles form sphincters at ureterovesicular junction to prevent backflow of urine and at neck of bladder to regulate urine emptying



Urethra

- Its wall has 4 tissue layers
 1. Tunica mucosa; epith transitional but changes to stratified squamous at external urethral orifice
 2. T. submucosa; has cavernous tissue spaces that are typical of erectile tissue
 3. T. muscularis; has inner and outer longi and middle layer of smooth muscles as in bladder but towards external urethral orifice, it acquires an external layer of skeletal muscle called striated urethralis muscle
 4. T. serosa/ adventitia

