



URINARY SYSTEM

جامعة ساوة

كلية الصيدلة

المرحلة الأولى

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MSc histology

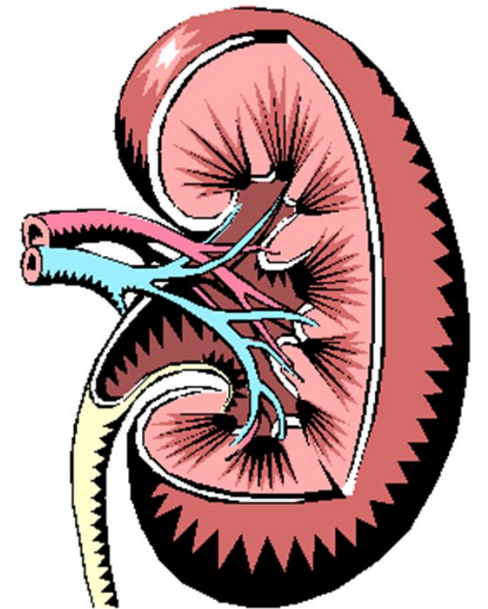
urinary system

The urinary system consists of two kidneys, two ureters, one bladder, and one urethra. It is an excretory system for urine and the wastes it carries. It extracts wastes from the bloodstream, converts them to urine, then transports and eliminates it.

The kidneys are bean-shaped organs located at the back of the abdominal cavity, lying on each side of the spinal column just above the waistline.

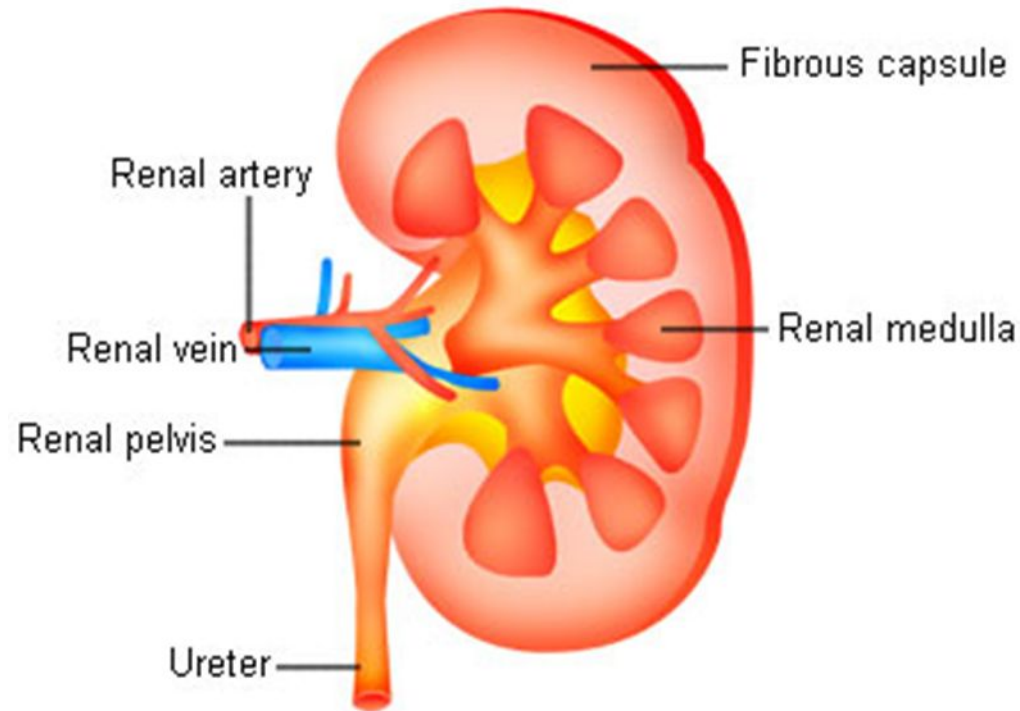
Three layers surround each kidney: the true capsule is a smooth, fibrous membrane adhering to the kidney surface; the perirenal fat is adipose tissue surrounding each kidney

the renal fascia is fibrous tissue that anchors the kidney to surrounding structures



The notch in the concave area of the kidney is called the **hilum** (HĪ lum). The renal artery, renal vein, nerves, and lymphatic vessels enter and leave through the hilum. The ureter also widens into a collection sac called the **renal pelvis** in the hilum area.

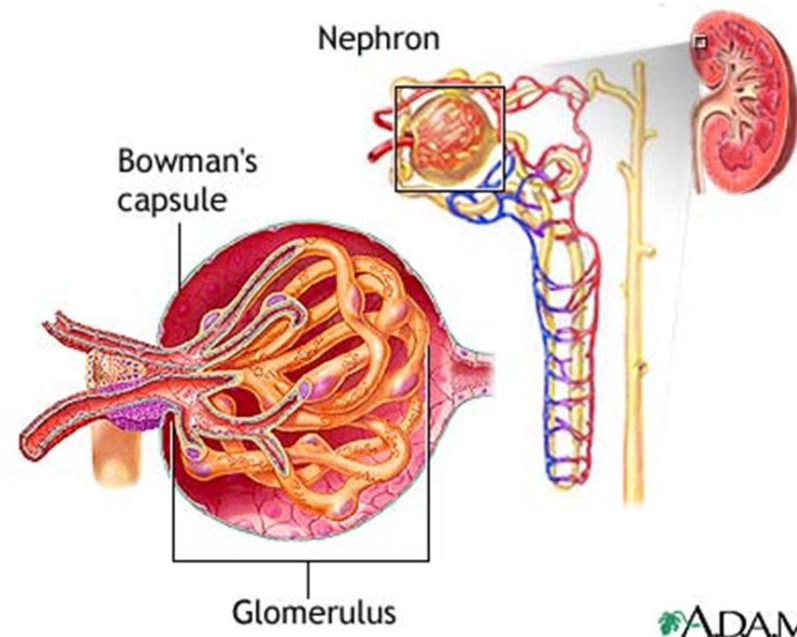
The renal cortex is the outside portion; the medulla is the inside.



Each kidney contains about 1 million nephrons, (NEF rahh) the structural and functional units of the kidney. Each nephron contains a Bowman's capsule and a glomerulus.

The nephron filters approximately 1,000 ml. of blood per minute... a little over a liter per minute. The waste is mixed with water to create urine: 5% solids in 95% water

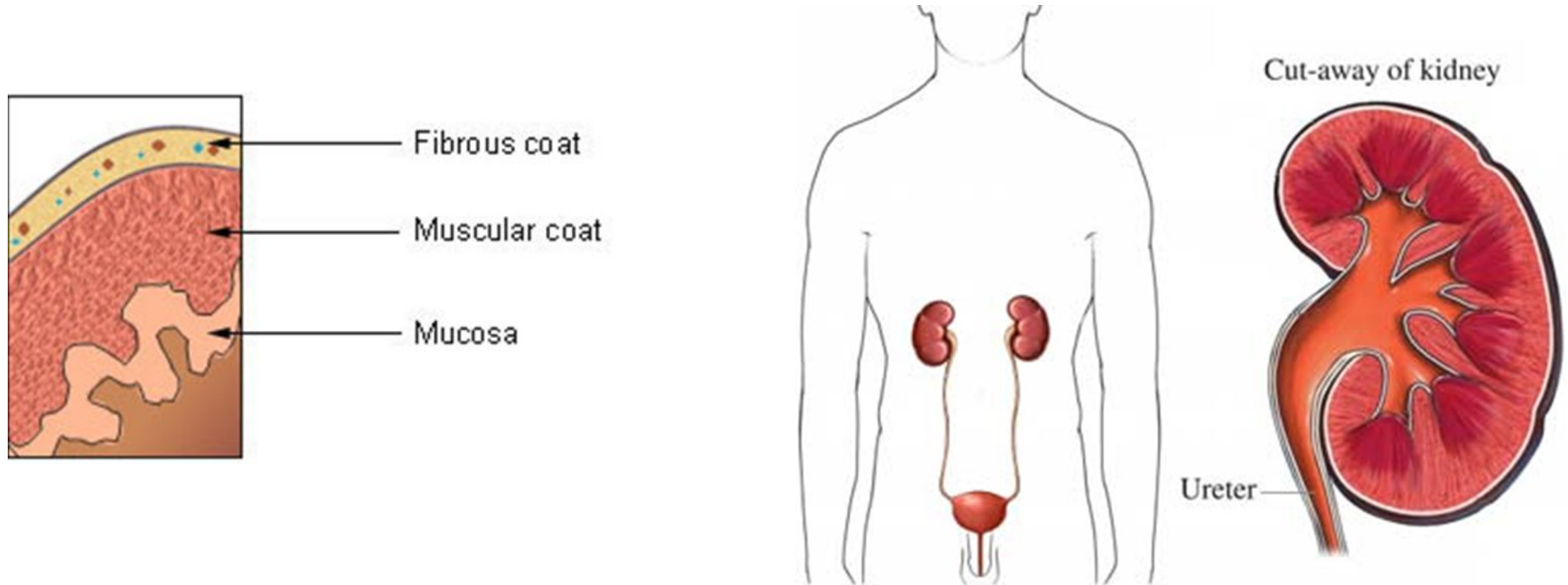
The nephron removes urea, uric acid, creatinine, and excess sodium, chloride, potassium ions, and ketone bodies from the blood. It also helps maintain normal fluid balances in the body by allowing reabsorption of water and some electrolytes back into the blood.



Ureters...

Each kidney has a ureter. It is a narrow, muscular tube about 11 inches in length and 3/8 inch in diameter.

Ureter walls have 3 layers: the inner mucous membrane, the middle smooth muscle, and the outer fibrous tissue.

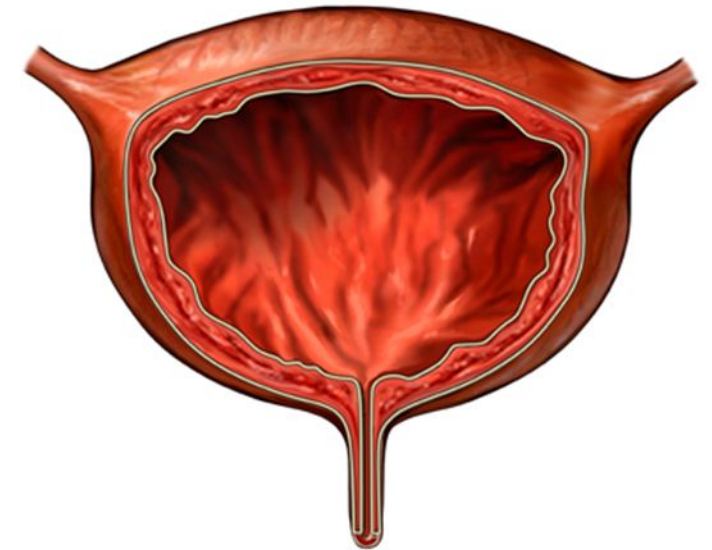
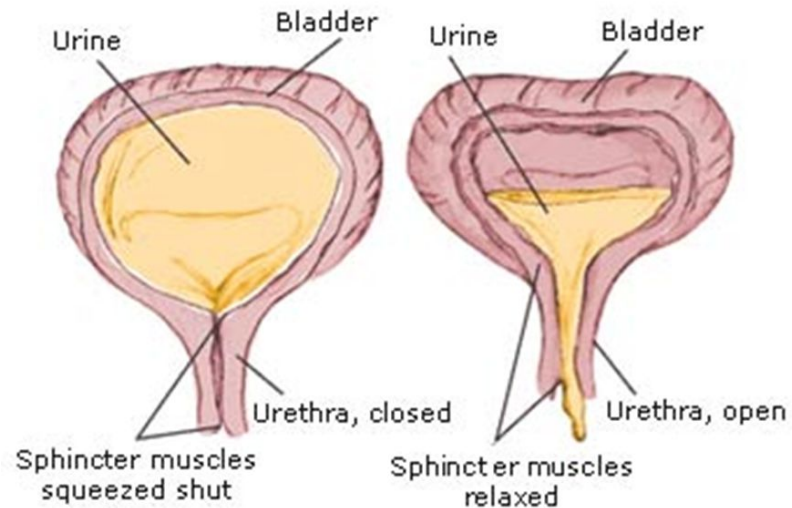


...The bladder

The urinary bladder is a muscular, membranous sac that serves as a reservoir for urine. The bladder has an upper portion called an apex, a neck that extends downward into the urethra, and the triangular trigone (TRĪ .gōan) near the base

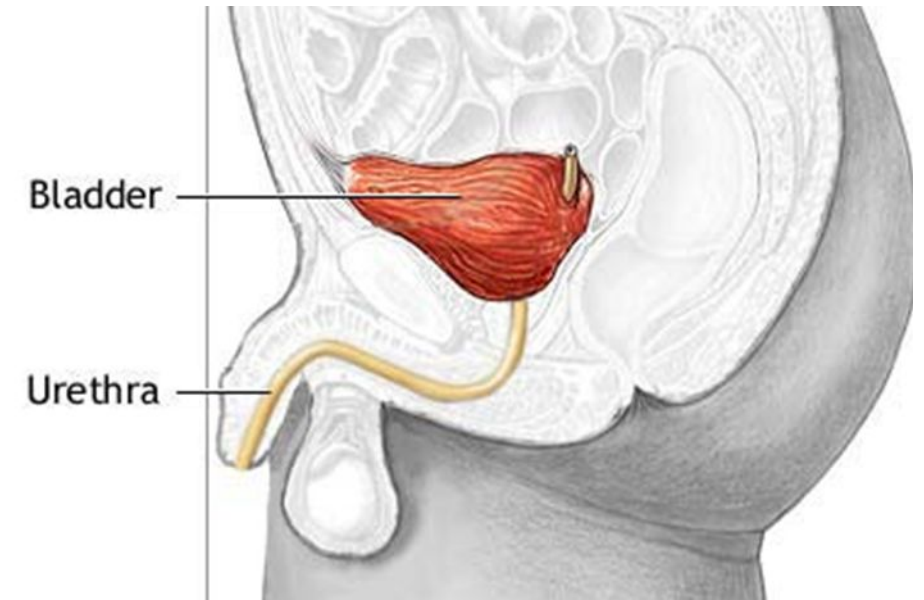
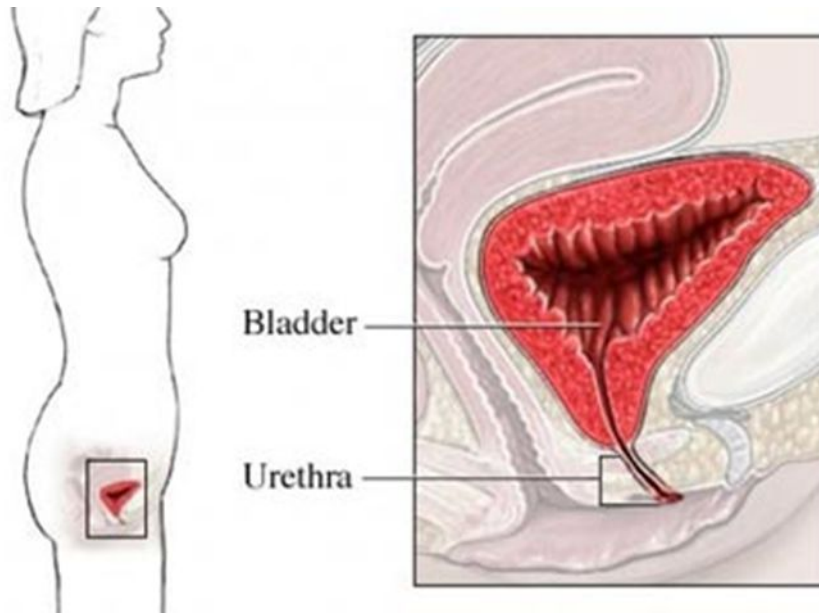
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The bladder has an inner mucous layer, an outside fibrous layer, and two inner muscle layers. As the bladder fills with urine, the muscular walls thin and expand.



The urethra...

The urethra extends from the bladder to the outside opening of the body called the urinary meatus. The urethra is about 7.8" long in the male, and transports both urine and semen. It is only about 1.2" long in the female and transports only urine.



Histology of urinary system

The Capsule

The kidney surface is covered by *dense irregular collagenous connective tissue* capsule which consist of two distinct layers : an **outer layer** of fibroblasts & collagen fibers, and **inner layer** with a cellular component of myofibroblasts.

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 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***

The podocytes have bundles of actin filaments in their cytoplasm that give them a contractile capacity,

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*** or ***columnar epithelium*** characterise of the proximal tubule .

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

Filtration apparatus of the kidney consisting of three components are :

- Endothelium of the glomerular capillaries , which possesses numerous fenestration, which are larger , more numerous & more irregular in outline than fenestration in other capillaries & absent the diaphragm.
- Glomerular basement membrane (GBM) , a thick basal lamina that is the joint product of the endothelium of capillaries & the podocytes with lamina densa & lamina rara , the cells of the visceral layer of Bowman's capsule . The GBM is principle component of the filtration barrier that separates the urinary space & the blood in the capillaries . the glomerular basement acts as a physical barrier & anion – selective filter .
- Visceral epithelial cells , which extend processes around the glomerular capillaries & develop numerous pedicles , interdigitate with secondary processes of neighboring podocytes .

Bladder and urinary passages :

The bladder and the urinary passage store the urine formed in the kidneys and conduct it to exterior .

- The calyces , renal pelvis , ureter, and bladder have the same basic histological structure, with the walls of the ureters become gradually thicker as proximity to the bladder increase.

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 ***thick 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
- . ***The adventitia*** is a fibroelastic connective tissue

2- pelvis :

The renal pelvis , subdivided into the minor 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 minor 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 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)***.

The epithelium of the bladder in the undistended state is **5 - 6** cells in thickness, the superficial cells are ***rounded*** when the epithelium is stretched , as when bladder is full of urine , the epithelium is only **3 - 4** cells in thickness and the superficial cells become ***squamous*** .

-Lamina propria which is a ***fibroelastic*** connective tissue & may contain occasional ***mucus glands*** .

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 .

4- Urethra

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

A- Male urethra it is about 20 cm long consists of three parts:

- **prostatic urethra** lined by **transitional epithelium** (urothelium) extend for 3 to 4 cm from the neck of the bladder through the prostate gland
- **The membranous urethra** extends for 1 cm & is lined with **stratified** or **pseudostratified columnar epithelium**. The **striated muscle** of the urogenital diaphragm surrounding this part of the urethra forms the **external sphincter** of the urethra.

Penile urethra the epithelium of this portion of the urethra is mostly **pseudostratified columnar** except the distal end which lined by **stratified squamous**.

B- Female urethra : It is a tube 4-5cm long, lined with **stratified squamous epithelium** & area **pseudostratified columnar epithelium** & the lamina propria is a highly vascularized layer of connective tissue that resembles the corpus spongiosum in the male & contain small **urethral glands**, the mid part of the female urethra is surrounded by an **external striated voluntary sphincter**