# Urinary System

Begins at the kidneys and includes (in order) the paired ureters, unpaired urinary bladder, and the urethra.

The process of urination is called micturition.

The urinary system is the principal system responsible for water and electrolyte balance. It also functions to excrete urea and creatinine (nitrogenous compounds).

Kidneys - 2 (paired) = normal condition. The left is higher than the right due to the presence of the liver on the right side of the bod.

Have a hilum for passage of

1. renal artery
2. renal vein
3. ureter
4. nerves

Kidneys are located retroperitoneal. They are embedded in fat. This fatty pouch consists of 3 layers:

1. Renal capsule - innermost layer. Is strong and fibrous. It is attached to the kidney. It functions to prevent infection.
2. Adipose capsule - second layer. Is a protective layer.
3. Renal fascia - third layer. Is a supportive layer. It anchors the kidney to the peritoneum and the abdominal wall.

Kidney structure Has two layers

1. Outer cortex - many capillaries
2. inner medulla - many blood vessels and tubules
    a. renal pyramids - tubules (tips = renal papilla)
    b. renal columns - separate pyramids. Transmit blood vessels

Nephron - the functional unit of the kidney. It functions to produce urine. It is made up of many tubules and their associated blood vessels.

Glomerulus - A tuft of capillaries with fenestrations

Glomerular (Bowman's) capsule - surrounds the glomerulus. Together they form the renal corpuscle. The epithelium of the glomerular capillaries contains pores called fenestrae. These allow filtrate to pass from the blood into the glomerular capsule (space).

Proximal convoluted tubule - long, with microvilli. It has simple cuboidal epithelium for resorption of salt, water, and other molecules needed by the body.

Nephron Loop (Loop of Henle) - has both ascending and descending limbs
Distal convoluted tubule - short, few microvilli. This tubule empties into the collecting duct.

Collecting duct -Passes through the renal pyramids and ends at the renal papillae where it empties into a minor calyx.

Blood supply

Renal arteries branch into segmental arteries which feed into interlobar arteries (in renal columns) which feed into arcuate arteries (branched out at the level between the cortex and medulla). Interlobular arteries branch off of the arcuate arteries and run out into the cortex. From these branch the afferent arterioles which bring blood to the glomeruli (blood filtrate enters the urinary tubules). Blood leaving the glomerulus enters an efferent arteriole which takes the blood to peritubular capillaries around the convoluted tubules OR vasa recta surrounding the ascending and descending limbs of the nephron loop. At this point the blood enters veins that parallel the arteries. That is, interlobular veins to arcuate veins to interlobar veins to segmental veins to renal veins to the inferior vena cava.

Notice that the left renal vein is longer. Why?

Ureters - are retroperitoneal and paired. They carry urine to the urinary bladder.

The wall of the ureter has 3 layers (tunics)

1. inner mucosa - continuous with the lining of the urinary bladder. It has transitional epithelium that secretes a protective mucous (lubrication)
2. middle layer - Muscularis. It has an inner longitudinal and outer circular layer of smooth muscle. The proximal 1/3 also has an outer longitudinal layer of smooth muscle.
3. Outer layer - fibrous coat made of loose CT. This coat covers the ureter and anchors it in place.

Urinary bladder - storage bag for urine. It is located behind the pubic symphysis yet in front of the rectum in males and in front of the uterus in females.

The wall of the urinary bladder has 4 layers:

1. Muscoa - innermost layer. Has transitional epithelium. Will find many folds (rugea) except in the area known as the trigone. This is a triangular area demarcated by three points, the two openings of the ureters and the exit point for the urethra.
2. Submucosa - supports the mucosa
3. Muscularis - has three layers called detrusor muscle. This muscle helps to form the internal urethral sphincter.
4. Serosa - outermost layer. It is found only on the superior surface of the bladder. It is actually a continuation of the peritoneum.

Urethra: carries the urine from the urinary bladder to outside the body

- female -short. Approx. 4 cm long
- male - longer. Consists of four regions
    1. preprostatic urethra – passes through the bladder wall
    2. prostatic urethra- passes through the prostate gland
    3. membranous urethra - passes through the urogenital diaphragm
    4. Penile (spongy) urethra - passes the length of the penis.

Urethral wall -The inside of the wall is lined by mucous membrane surrounded by a thick layer of smooth muscle. We also see urethral glands which secrete mucous into the urethral canal. There is an external urethral sphincter which is composed of voluntary skeletal muscle of the urogenital diaphragm.

Micturition = urination, which is a reflex action. Stretch receptors activate the detrusor muscle and relax the internal urethral sphincter. The external urethral sphincter is under voluntary control after approx.. 2 years of age. This has to do with growth of the spinal cord and appropriate nerves.