

The Urinary System

Urine production and elimination are one of the most important mechanisms of body homeostasis

‡ composition of blood is determined more by kidney function than by diet

all body systems are directly or indirectly affected by kidney function

kidney function is closely tied to circulatory system

main function of kidneys is to get rid of metabolic wastes
‡ typically referred to as “**excretory system**”

excretory wastes = **metabolic wastes**

‡ chemicals & toxins produced by cells during metabolism

but we have several organs that serve an **excretory function** other than kidneys:

1. **kidneys**

2. **skin**

sweat glands rid body of water, minerals,
some nitrogenous wastes (ammonia)

3. **lungs**

rid body of CO₂ from energy metabolism of cells

4. **intestine**

in addition to getting rid of undigested food residue
feces also contains some metabolic wastes as well

bile pigments

salts

calcium

some toxins

General Functions of Urinary System:

1. removal of metabolic wastes & toxins
2. elimination of excess nutrients & excess hormones
3. regulation of blood volume & pressure
4. regulation of electrolytes & body pH
5. erythropoiesis
6. aid in calcium absorption

Anatomy of Urinary System

Organs:

- kidneys** – clean and filter blood
- ureters** – tubes that take urine to bladder
- bladder** – stores urine until eliminated
- urethra** – removes urine from body

1. kidneys

dorsal body wall

retroperitoneal ‡ behind parietal peritoneum

just above waist

surrounded by **renal capsule**

‡ barrier against trauma and spread of infections

hilum = indentation where vessels and ureter attach

Frontal Section of Kidney

cortex

outer zone of kidney

medulla

interior of kidney

extensions of the cortex = **renal columns**

divides the medulla into 6-10 **renal pyramids**

papilla of each pyramid nestled in cup shaped **calyces**

calyces converge to form **renal pelvis**

2. ureters

the rest of urinary system is “plumbing”

renal pelvis funnels urine to paired **ureters**

‡ tubular extensions of renal pelvis

peristalsis moves urine along to bladder

3. bladder

small, size of walnut when empty
can hold up to 800 ml (24 oz) voluntarily

where urethra passes through pelvic floor it is encircled by and **external urethral sphincter** of skeletal muscle
‡ provides voluntary control

4. urethra

male:

~18 cm long

dual function

‡ rid body of urine

‡ release of seminal fluid during orgasm

female:

tube 3-4 cm long

single function: rids body of urine shorter

‡ more prone to UTI's

Histology of Kidney

nephron = functional units of kidneys

each kidney is composed of over 1 million nephrons

two basic parts:

nephric tubule = microscopic, highly convoluted tubule

associated **blood supply**

nephron is basic functional unit of the urinary system can find various parts of the nephron and its blood supply in the **cortex** and **medulla** of kidney

Nephric Tubule

the nephric tubule is organized into several discrete structures:

Bowman's Capsule

cup shaped mouth of nephron

usually in cortex

Proximal Convoluted Tubule

attached to Bowman's Capsule

highly coiled (convoluted)

inner surface contains microvilli

Loop of Henle

large loop consisting of:
descending limb &
ascending limb
extends down into medulla

Distal Convoluted Tubule

appears similar to PCT

Collecting Tubule

many DCT's drain into one collecting tubule
bundles of collecting tubules = **pyramids**

Pyramids drain into **Calyces** (sing. = **calyx**)

Calyces coalesce to form **pelvis**

Blood Supply

kidneys are highly vascularized
 $\frac{1}{5}$ = 1/5th of cardiac output
all blood ~60x's/day

Afferent Arteriole

bring blood to individual nephrons

Glomerulus

dense capillary bed
formed by afferent arteriole
inside Bowman's capsule

Bowman's Capsule + Glomerulus = Renal Corpuscle

Efferent Arteriole

blood leaves glomerulus via efferent arteriole
[$\frac{1}{5}$ artery $\frac{1}{5}$ capillary bed $\frac{1}{5}$ artery]

Peritubular Capillaries

efferent arteriole divides into another capillary bed
surrounds the rest of the nephric tubule
(PCT-LH-DCT-CT)