CHAPTER 25
The Urinary System

Urinary System Organs

- Kidneys
  - Produce urine
- Ureters
  - Pass urine from kidneys to bladder
- Urinary bladder
  - Storage of urine
- Urethra
  - Passes urine from the body

Urinary System Functions

- Regulation of blood volume & composition
  - And thereby of interstitial fluid and body
- Regulation of blood pH
  - By controlling H+ excretion /retention of bicarb
- Regulation of blood pressure
  - Via the renin-angiotensin-aldosterone system
- Metabolism of:
  - Ca++ balance (conversion of Vitamin D)
  - RBC formation (erythropoetin secretion)
  - Gluconeogenesis (occurs in starvation)
Kidney Anatomy
- Renal Sinus
- Renal Pelvis
- Major Calyces (2-3)
- Minor Calyces (8-18)
- Renal Capsule
- Renal Cortex
  - Renal Columns
- Renal Medulla
  - Renal Pyramids

Nephrons
- Functional unit of the kidney
- Approximately 1 million nephrons – number constant from birth
- Damaged nephrons do not regenerate
- Two major types
  - Cortical nephrons
  - Juxtamedullary nephrons
    - Create the Vertical Osmotic Gradient

Major parts of the nephron
- Renal corpuscle
  - Glomerulus
    - Capillary bed
    - Bowman’s capsule/glomerular capsule
- Renal tubule
  - Proximal convoluted tubule
  - Loop of Henle
    - Descending limb
    - Ascending limb
  - Distal convoluted tubule
- Nephrons connect to the collecting ducts
**Filtration Membrane**
- Fenestrations in endothelium
- Stops cells
- Basement membrane
- Stops large proteins
- Slit membrane / slit diaphragm (between pedicles)
- Stops medium-sized proteins

**Blood Flow in the Kidney**
- Kidneys make up only 1% of total body mass but receive 20-25% of blood flow of resting cardiac output ~ 1200 ml/min
- Our 3rd portal system is located in the kidney
- The portal vein in this case is called the efferent arteriole.
- Lies between the glomerulus and the peritubular capillaries or vasa recta
- Memorize blood flow through the kidney
Urine production

- Renal corpuscles produce 180 liters of filtrate/day
- Plasma volume would be depleted in ~ 30 minutes
- Reabsorption of most of the filtrate in the tubule
- Secretion of wastes into the tubule

3 processes in urine production

- Filtration
  - Occurs in the renal corpuscle
- Reabsorption
  - Occurs in the renal tubule
- Secretion
  - Occurs in the renal tubule

Major parts of the nephron

- Ureters
  - Extension of the renal pelvis
  - 10-12" long
  - Retroperitoneal
  - Stretching of filling bladder creates physiological sphincters
  - Muscularis
    - Inner longitudinal
    - Outer circular
    - Transitional epithelium

Urinary Bladder

- Retroperitoneal
- Collapsed when empty
- Average capacity ~ 800 mls
- Transitional Epithelium
- Trigone
  - Smooth appearance
  - Frequently the sight of infection
- Detrusor muscle
  - Inner longitudinal
  - Middle circular
  - Outer longitudinal
Urethra

- Passageway for urine to leave the bladder
- Internal sphincter
  - Smooth muscle
- External sphincter
  - Skeletal muscle
- Female ~ 1.5 inches
  - Orifice located between the clitoris and vagina
- Male ~ 8 inches
  - Prostatic urethra
  - Membranous (intermediate) urethra
  - Spongy (penile) urethra
Learning Objectives

- List the organs of the urinary system and give general functions for each
- Describe the major parts of the kidney
- Describe a nephron and list all parts and include where each of the 3 processes of urine formation occur
- Describe the filtration membrane of the glomerulus

Learning Objectives

- Describe the blood flow pathways within the kidney
- Which vessel is considered a portal vein?
- Discuss the anatomy and histology of the ureters and the urinary bladder
- Discuss the differences between the male and female urethra