16 The Urinary System

Chapter Outline

Urinary System
- Functions of the Urinary System
- Urinary Organs
- Micturition

Urine Formation
- Steps in Urine Formation
- Concentrated Urine
- Special Features of the Nephron

Regulatory Functions of the Kidney
- Fluid and Electrolyte Balance
- Acid-Base Balance

Working Together: The Urinary System

Learning Objectives

1. Name the organs of excretion, and tell what wastes they excrete.
2. List and discuss the functions of the urinary system.
3. Describe the macroscopic and microscopic anatomy of the kidney.
4. State the parts of a kidney nephron, and relate them to the gross anatomy of the kidney.
5. Name and describe the structure and function of each organ in the urinary system.
6. Trace the path of urine, and describe how micturition is controlled.
7. State, in general, the characteristics of normal urine.
8. Describe the three steps in urine formation, and relate them to parts of a nephron.
9. Describe how the kidneys help maintain the fluid, electrolyte, and acid-base balance of blood.
10. Name and explain how three hormones work together to maintain blood volume and pressure.

Medical Terminology

Medical Term	Meaning
cortex	shell, outer layer
-diuresis	large urine volume
medulla	inner portion

1. Where is the cortex in the kidney?

2. Where is the medulla in the kidney?

3. What is the action of the antidiuretic hormone?

New Terms

Basic Key Terms

aldosterone
antidiuretic hormone (ADH)
atrial natriuretic hormone
buffer
collecting duct
distal convoluted tubule
electrolytes
glomerular capsule
glomerulus
kidney
micturition
nephrons
peritubular capillary network
proximal convoluted tubule
renal cortex
renal medulla
renal pelvis
ureters
urethra
urinary bladder

Clinical Key Terms

benign prostatic hyperplasia
diuretics
floating kidney
gout
incontinence
uremia
urinalysis

Study Questions

Introduction (p. 320)

List the waste products of metabolism for each of the following excretory organs.

1. skin _____
2. lungs _____
3. liver _____

Urinary System (pp. 320–23)

A. Match the description on the left with the corresponding structures on the right. Letters can be used more than once. Place the correct letters in the blanks on the left.

____ 1. produces urine
____ 2. differs markedly in length between the two sexes
____ 3. encircled by the prostate gland in males
____ 4. lies against the deep muscles of the back
____ 5. tube with middle layer of smooth muscle
____ 6. stores up to 600 milliliters of urine

a. kidney
b. ureter
c. urethra
d. urinary bladder

B. In the blanks on the left, use the numbers *1* through *4* to indicate the transport of urine through the urinary system. Label the first structure to transport urine as number *1*.

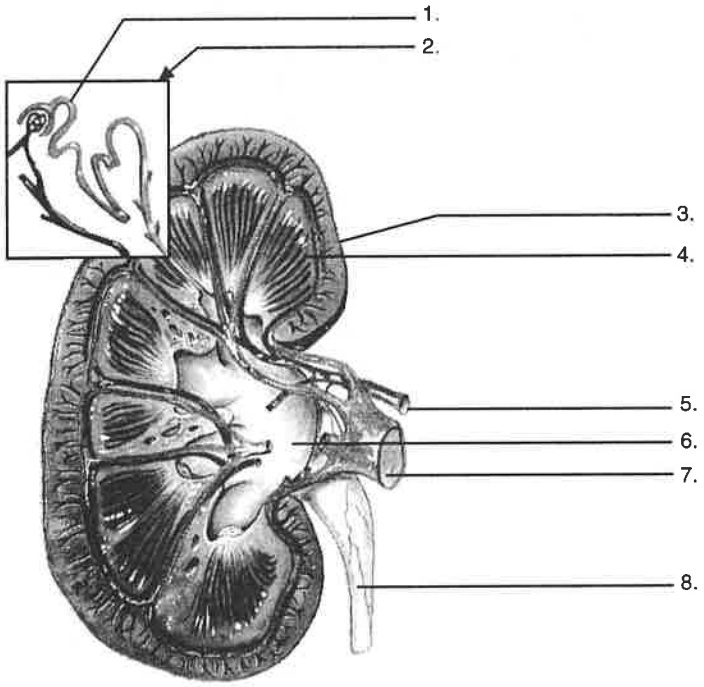
____ kidney
____ ureter
____ urethra
____ urinary bladder

C. Match each kidney structure on the left with the corresponding description on the right. Place the correct letters in the blanks on the left.

____ 1. calyx
____ 2. renal cortex
____ 3. hilum
____ 4. renal medulla
____ 5. renal pelvis

a. depression on concave side of the kidney
b. inner cavity
c. outer granulated layer
d. radially striated layer
e. structure at the tip of each renal pyramid

D. Use the terms that follow to label the diagram of the kidney (text figure 16.2*b*, p. 321). Write the correct label in the space provided beside each numbered pointer.



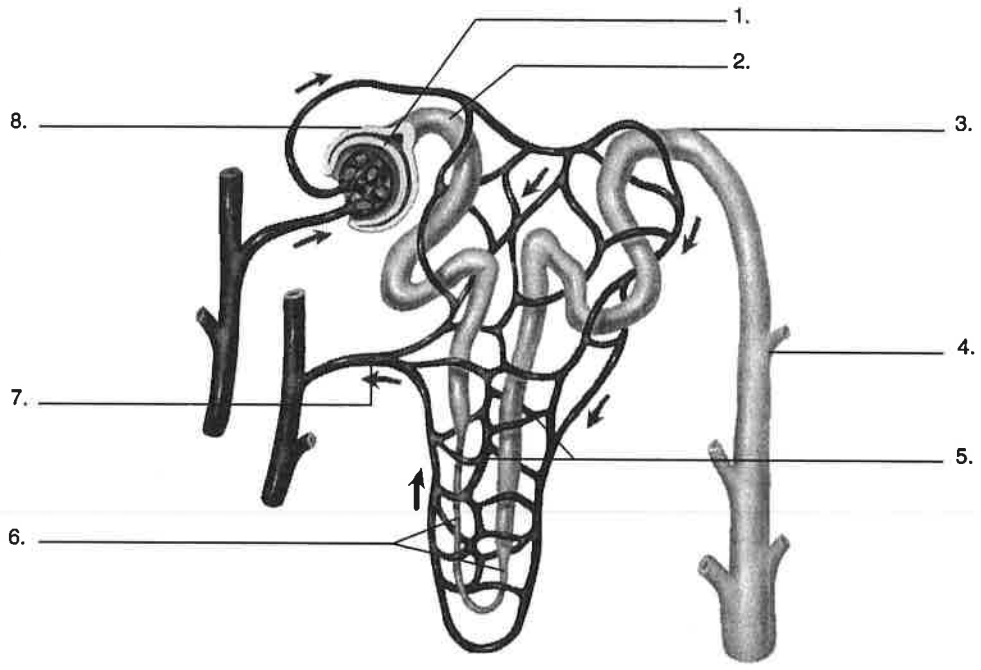
afferent arteriole
cortex
medulla
nephron
renal artery
renal pelvis
renal vein
ureter

E. Match the nephron structures on the left with the corresponding descriptions on the right. Place the correct letters in the blanks on the left.

____ 1. convoluted tubule
____ 2. glomerular capsule
____ 3. glomerulus
____ 4. loop of Henle
____ 5. peritubular

a. group of capillaries inside capsule
b. can be proximal or distal
c. cuplike structure
d. U-shaped
e. capillary network surrounding most of the nephron

F. Use the terms that follow to label the diagram of the nephron (text figure 16.2*c*, p. 321). Write the correct label in the space provided beside each numbered pointer.



collecting duct
distal convoluted tubule
glomerular (Bowman's) capsule
glomerulus
loop of the nephron (loop of Henle)
peritubular capillaries
proximal convoluted tubule
venule

G. Use the terms that follow to fill in the blanks in the paragraph describing micturition.

brain
sphincter
stretch
urethra

When the bladder becomes filled with urine, 1._____ receptors in the wall of the bladder send nerve impulses to the 2._____ in the central nervous system. The brain sends a signal that produces a relaxation of the external 3._____ in the 4._____ of the urinary tract.

III. Urine Formation (pp. 323–27)

A. Match the descriptions on the left with the steps in urine formation on the right. Letters can be used more than once. Place the correct letters in the blanks on the left.

____ 1. occurs at the glomerular capsule
____ 2. occurs mainly at the distal convoluted tubule
____ 3. occurs mainly at the proximal convoluted tubule
____ 4. materials enter the peritubular capillaries
____ 5. plays a minor role in urine formation
____ 6. water, nutrients, and wastes move into the glomerular capsule

a. pressure filtration
b. selective reabsorption
c. tubular secretion

B. Match the descriptions on the left with the structures on the right. Letters can be used more than once. Place the correct letters in the blanks on the left.

____ 1. cells have numerous microvilli
____ 2. close to the juxtaglomerular apparatus
____ 3. extrudes sodium, reabsorbs water
____ 4. has a descending and ascending limb
____ 5. inner layer is made of podocytes
____ 6. site of tubular secretion

a. distal convoluted tubule
b. glomerular capsule
c. loop of the nephron
d. proximal convoluted tubule

IV. Regulatory Functions of the Kidney (pp. 327–30)

A. Complete each of the following statements with the term *increases* or *decreases.*

1. As the reabsorption rate of a substance increases, its rate of elimination _____ .
2. ADH secretion _____ the permeability of the collecting duct to water.
3. ADH activity _____ reabsorption.
4. When water is reabsorbed at the collecting duct, blood volume _____ .
5. Drinking alcohol _____ diuresis.
6. An increase in ADH secretion _____ the amount of urine formed.
7. Aldosterone release _____ potassium (K^+) secretion.
8. If blood pressure _____ , renin secretion can rise.
9. Angiotensin stimulation _____ aldosterone secretion.
10. As the heart is stretched when filled with more blood, the release of ANH from the heart _____ .

B. Complete each of the following statements.

1. _____ are compounds that can ionize in water and conduct a current of electricity.
2. A _____ is a chemical or combination of chemicals that can stabilize the pH of a solution.
3. _____ ions can combine with excess hydrogen ions to form carbonic acid.
4. The kidneys can excrete excess _____ ions to oppose acidity in the blood.

V. Effects of Aging (p. 331)

Indicate whether each of the following statements is true (T) or false (F).

____ 1. The kidneys usually enlarge as a person ages.
____ 2. The kidneys lose nephrons with increasing age.
____ 3. Kidney stones occur more frequently as a person ages.
____ 4. Incontinence occurs when urine is retained in the body.