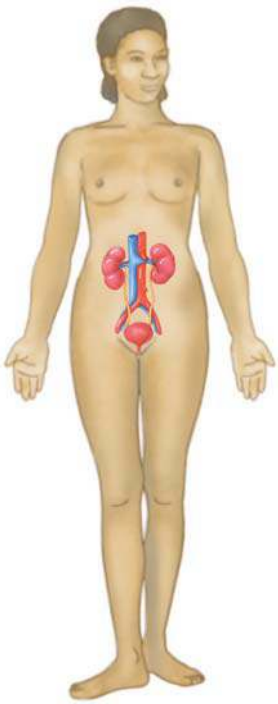
CHAPTER 9

The Urinary System

▶ UROLOGY



After studying this chapter, you will be able to:

- 9.1 Name the parts of the urinary system and discuss the function of each part
- 9.2 Define combining forms used in building words that relate to the urinary system
- 9.3 Identify the meaning of related abbreviations
- 9.4 Name the common diagnoses, clinical procedures, and laboratory tests used in treating disorders of the urinary system
- 9.5 List and define the major pathological conditions of the urinary system
- 9.6 Explain the meaning of surgical terms related to the urinary system
- 9.7 Recognize common pharmacological agents used in treating disorders of the urinary system

Structure and Function

The **urinary system** (also called the *renal system* or *excretory system*) maintains the proper amount of water in the body and removes waste products from the blood by excreting them in the urine. The urinary system consists of:

- Two **kidneys,** organs that remove dissolved waste and other substances from the blood and urine
- Two **ureters,** tubes that transport urine from the kidneys to the bladder
- The **bladder,** the organ that stores urine
- The **urethra,** a tubular structure that transports urine through the **meatus,** the external opening of a canal, to the outside of the body

Figure 9-1a shows the urinary system, and Figure 9-1b diagrams the path of urine through the system.

Kidneys

The National Kidney Foundation has many educational links on its Web site (www.kidney.org).

Each kidney is a bean-shaped organ about the size of a human fist, weighs about 4 to 6 ounces, and is about 12 centimeters long, 6 centimeters wide, and 3 centimeters thick. The kidneys are located in the **retroperitoneal** (posterior to the peritoneum) space behind the abdominal cavity on either side of the vertebral column. The kidneys sit against the deep muscles of the back surrounded by fatty and connective tissue. The left kidney is usually slightly higher than the right one.

The kidneys serve two functions—to form urine for excretion and to retain essential substances the body needs in the process called *reabsorption*.

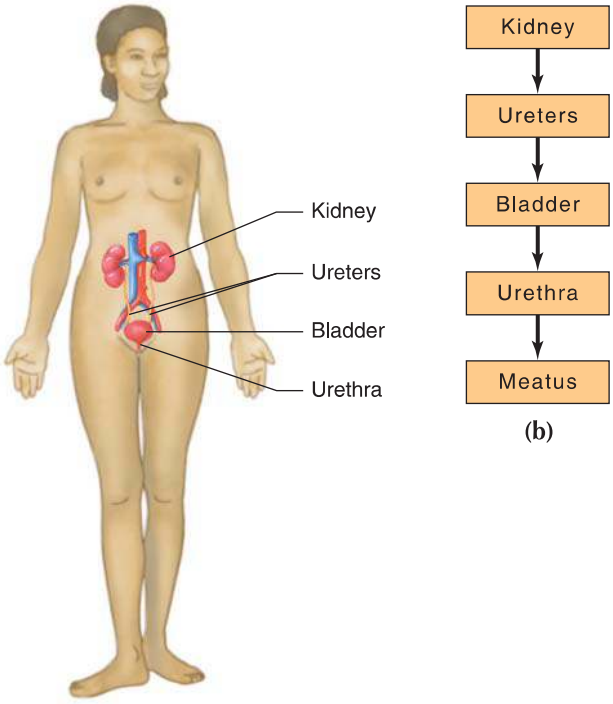


FIGURE 9-1 **(a)** An illustration of the urinary system; **(b)** a diagram of the path of urine through the system.

Urine is produced by **filtration** of water, salts, sugar, **urea,** and other nitrogenous waste materials such as **creatine** (and its component **creatinine**) and **uric acid.** The excretion rate of creatinine is measured in urinary tests because it is an indicator of how the kidney is functioning. Kidneys, in the average adult, will filter about 1700 liters of blood per day. Urine output is the only means for the body to remove toxic nitrogenous wastes from the body.

The kidneys have an outer protective portion, the **cortex,** and an inner soft portion, the **medulla,** which is a term used for the inner, soft portion of any organ. In the middle of the concave side of the kidney is a depression, the **hilum,** through which the blood vessels, the nerves, and the ureters enter and exit the kidney.

The functional unit of the kidney is the **nephron** (Figure 9-2). The nephron removes waste products from the blood and produces **urine.** Each kidney contains about one million nephrons, more nephrons than one person needs. That is why people can live a normal life with only one kidney.

Blood enters each kidney through the *renal artery* and leaves through the *renal vein*. Once inside the kidney, the renal artery branches into smaller arteries called *arterioles*. Each arteriole leads into a nephron. Each nephron contains a *renal corpuscle* made up of a group of capillaries called a **glomerulus** (*pl.*, **glomeruli**) (Figure 9-3). The glomerulus filters fluid from the blood and is the first place where urine is formed in the kidney. Each nephron also contains a *renal tubule*, which carries urine to ducts in the kidney's cortex. Blood flows through the kidneys at a constant rate. If the blood flow is decreased, the kidney automatically produces **renin,** a substance that causes an increase in the blood pressure in order to maintain the filtration rate of blood. The wall of each glomerulus is thin enough to allow water, salts, sugars, urea, and certain wastes to pass through. Each glomerulus is surrounded by a capsule, **Bowman's capsule,** where this fluid collects. The filtered substances that are removed from the blood then pass into the renal tubules.

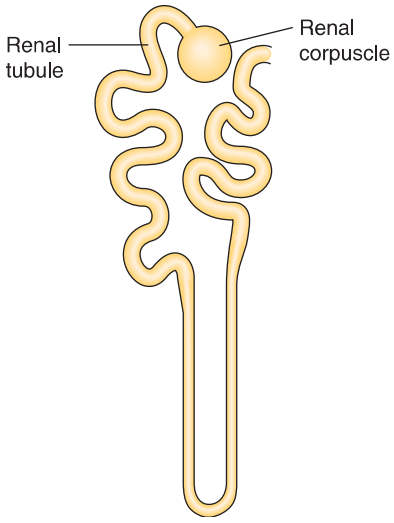


FIGURE 9-2 A nephron contains both a renal corpuscle and a renal tubule.

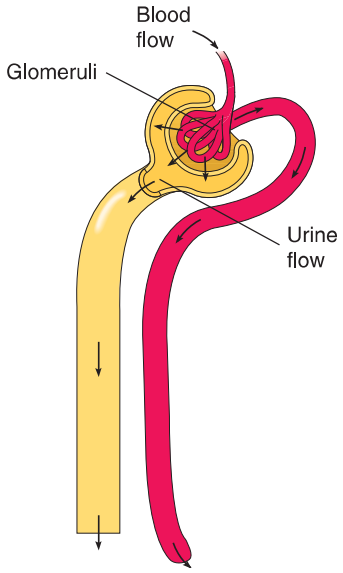


FIGURE 9-3 Blood flows into the glomeruli where urine is excreted and moved to the kidney's cortex.

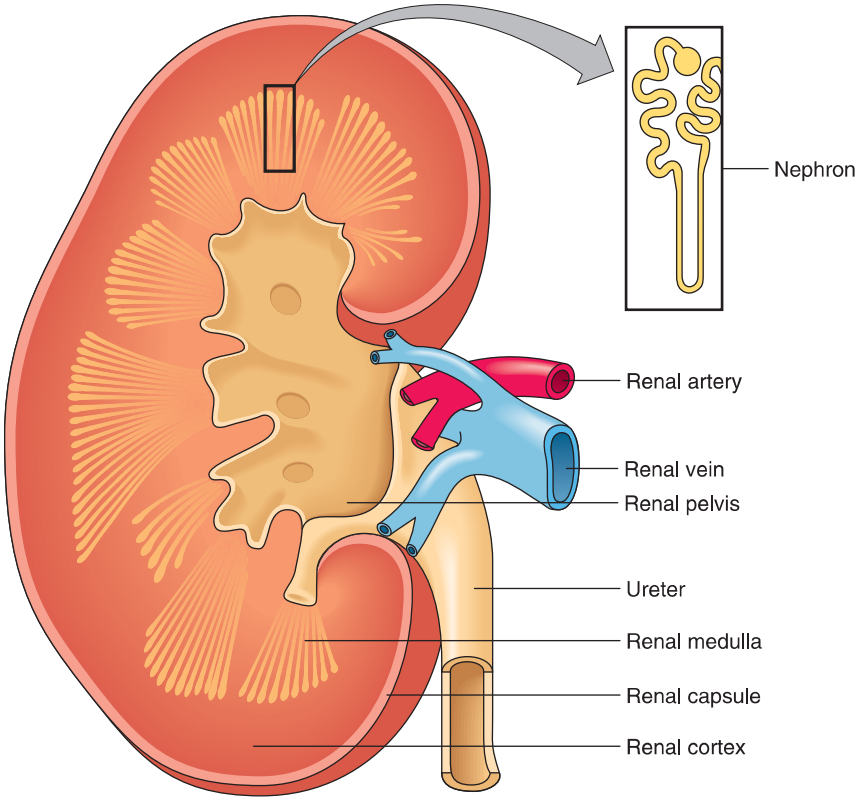
MORE ABOUT . . .

Blood Pressure and the Kidneys

The kidneys have mechanisms to maintain *homeostasis* (equilibrium) in the filtration rate of the glomeruli. The constant flow of water and its substances back into the bloodstream and the flow of water and waste substances into the renal tubule maintain the body's balance of water, salts (the most common salt in the body is sodium chloride), sugars (the most common sugar in the body is glucose), and other substances. To do this, the kidneys have two lines of defense. The first is the automatic dilating and constricting of the arterioles as needed to increase or decrease the flow of blood into the glomeruli. The second is to release renin to increase the blood pressure and thus the filtration rate of blood to maintain a constant supply. Maintaining homeostasis affects blood pressure either by lowering it when blood is flowing too quickly or by increasing it when blood is flowing too slowly. Some forms of high blood pressure are caused by the effort of poorly functioning kidneys to maintain homeostasis.

Substances held in the renal tubule that can be used by the body are reabsorbed back to the bloodstream. During this **reabsorption,** most of the water, nutrients including glucose, and selected electrolytes move back to the blood. Any substance *not* reabsorbed will become urine. Urine travels to the **renal pelvis,** a collecting area in the center of the kidney. Pelvis is a general term for the collecting area of an organ or system. The renal pelvis

FIGURE 9-4 The kidneys form urine for excretion and retain essential substances for reabsorption.



contains small cuplike structures called **calices** (also spelled **calyces;** singular **calyx)** that collect urine. Figure 9-4 shows the parts of a kidney involved in urine flow.

Ureters

Attached to each kidney is a *ureter,* a tube (usually 16 to 18 centimeters long) that transports urine from the renal pelvis to the urinary bladder. The two ureters are made up of three layers of tissue—smooth muscle, fibrous tissue, and a mucous layer. *Peristalsis*, a rhythmic contraction of the smooth muscle, helps to move urine into the urinary bladder.

Bladder

The **urinary bladder** is a hollow, muscular organ that stores urine until it is ready to be excreted from the body. *Bladder* is a general term meaning a receptacle. Urine is pumped into the bladder every few seconds. The *sphincter muscles*, muscles that encircle a duct to contract or expand the duct, hold the urine in place. Control of urination has to be taught to young children (usually between the ages of one and three), while in adults it is usually easily controlled. The bladder can hold from 300 to 400 milliliters of urine before emptying. The bladder's walls contain epithelial tissue that can stretch and allow the bladder to hold twice as much as it does when normally full. The walls also contain three layers of muscle that help in the emptying process. The base of the bladder (Figure 9-5) contains a triangular area, the **trigone,** where the ureters enter the bladder and the urethra exits it.

Urethra

Urine is excreted outside the body through the urethra, a tube of smooth muscle with a mucous lining. The female urethra is only about 4 centimeters [1.5 inches] long. It opens through the meatus, which is located at the distal end of the urethra between the clitoris and the vagina. The male urethra is about 20 centimeters [8 inches] long and passes through three different regions. The first region is the **prostate,** a gland where the urethra and the ejaculatory duct meet. Thus, the urethra in the male is part of the urinary system as well as part of the reproductive system. The second region is a membranous portion, after which urine passes into the third part, the penis, and is excreted through the meatus at the distal end of the penis. Excreting urine is called *voiding* or *micturition*.

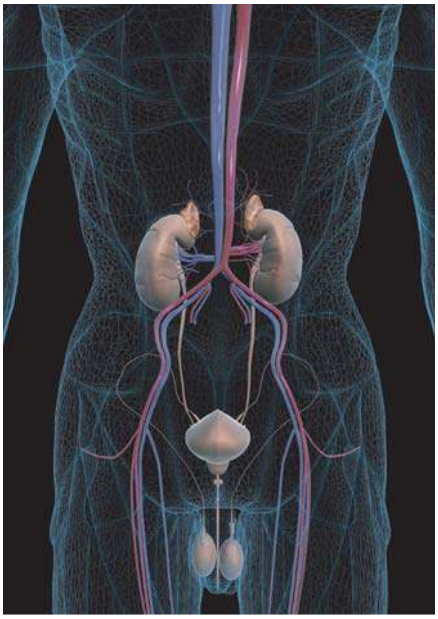


FIGURE 9-5 A photograph showing the male urinary system with the ureters leading from the kidneys to the bladder in which urine is stored and then released into the urethra to exit the body.

Vocabulary Review

In the previous section, you learned terms relating to the urinary system. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
bladder [BLĂD-ĕr] Old English *blaedre*	Organ where urine collects before being excreted from the body.
Bowman's [BŌ-măns] **capsule** After Sir William Bowman (1816–1892), English anatomist	Capsule surrounding a glomerulus and serving as a collection site for urine.
calices, calyces (*sing.*, calix, calyx) [KĂL-ĭ-sēz (KĀ-lĭks)] From Greek *kalyx*, cup of a flower	Cup-shaped structures in the renal pelvis for the collection of urine.
cortex [KŌR-tĕks] Latin, bark	Outer portion of the kidney.
creatine [KRĒ-ă-tēn] From Greek *kreas*, flesh	Substance found in urine; elevated levels may indicate muscular dystrophy.
creatinine [krē-ĂT-ĭ-nēn]	A component of creatine.
filtration [fĭl-TRĀ-shŭn]	Process of separating solids from a liquid by passing it through a porous substance.
glomerulus (*pl.*, glomeruli) [glō-MĀR-yū-lŏs (glō-MĀR-yū-lī)] From Latin *glomus*, ball of yarn	Group of capillaries in a nephron.
hilum [HĪ-lŭm] Latin, a small bit	Portion of the kidney where blood vessels and nerves enter and exit.
kidney [KĬD-nē] Middle English, *kidenei*	Organ that forms urine and reabsorbs essential substances back into the bloodstream.
meatus [mē-Ă-tŭs] Latin, passage	External opening of a canal, such as the urethra.
medulla [mĕ-DŪL-ă] Latin, marrow	Soft, central portion of the kidney.
nephron [NĔF-rŏn] From Greek *nephros*, kidney	Functional unit of a kidney.
prostate [PRŎS-tāt] Greek *prostates*, one that protects	Gland surrounding the urethra in the male; active in ejaculation of semen.
reabsorption [rē-ăb-SŎRP-shŭn] re + absorption	Process of returning essential elements to the bloodstream after filtration.
renal pelvis	Collecting area for urine in the center of the kidney.
renin [RĔ-nĭn] Latin *ren*, kidney	Enzyme produced in the kidneys to regulate the filtration rate of blood by increasing blood pressure as necessary.
retroperitoneal [RĔ-trō-PĔR-ĭ-tō-nē-ăl] retro-, behind + peritoneal	Posterior to the peritoneum.
trigone [TRĪ-gōn] Latin *trigonum*, triangle	Triangular area at the base of the bladder through which the ureters enter and the urethra exits the bladder.

Term	Definition
urea [yū-RĒ-ă] Greek *ouron*, urine	Waste product of nitrogen metabolism excreted in normal adult urine.
ureter [yū-RĒ-tĕr] Greek *oureter*, urinary canal	One of two tubes that conduct urine from the kidney to the bladder.
urethra [yū-RĒ-thră] Greek *ourethra*	Tube through which urine is transported from the bladder to the exterior of the body.
uric [YŪR-ĭk] **acid** ur-, urine + -ic, pertaining to	Nitrogenous waste excreted in the urine.
urinary [YŪR-ĭ-nār-ē] **bladder**	*See* bladder.
urinary system	Body system that forms and excretes urine and helps in the reabsorption of essential substances.
urine [YŪR-ĭn] Greek *ouron*, urine	Fluid excreted by the urinary system.

CASE STUDY

Visiting a Clinic

Central Valley HMO is located in a large medical office building next to a hospital complex. The first floor is a large clinic where patients are evaluated first. Later, they may be referred to specialists located in the same building.

Three of the morning patients complained of problems relating to the urinary system. The first, Mr. Delgado, was having difficulty urinating. The second, Ms. Margolis, showed blood in her urine, and the third, Ms. Jones, complained of frequent, painful, and scanty urination. All three were seen by Dr. Chorzik, a family practitioner employed by the HMO.

Critical Thinking

1. Is blood normally seen in the urine? Why or why not?
2. Does the fact that Mr. Delgado and Ms. Jones are of different sexes make the diagnosis of their urinary problems different?

STRUCTURE AND FUNCTION EXERCISES

Check Your Knowledge

Fill in the blanks.

3. Urine is transported within the urinary system via the _____.
4. Urine is transported to the outside of the body via the _____.
5. Each kidney has about one million _____.
6. The renal corpuscle contains a mass of capillaries termed a _____.
7. The collecting area in the center of the kidney is called the _____.
8. The return of essential substances to the bloodstream is called _____.
9. The urethra draws urine from the _____.
10. Two words meaning excreting urine are _____ and _____.

11. A fluid collection site in a nephron is called a _____.
12. A triangular area at the base of the bladder is called a _____.

Check Your Accuracy

Circle T for true or F for false.

13. The loss of one kidney is fatal. T F
14. The urethra transports urine from the kidney to the bladder. T F
15. Most of the water and sugar filtered in the kidney are reabsorbed. T F
16. Renin increases blood flow through the kidneys. T F
17. Two fluid collection sites within the kidney are the calices and the Bowman's capsule. T F
18. The female urethra is longer than the male urethra. T F
19. The female urethra opens into the vagina. T F
20. The prostate gland ejects semen into the male urethra. T F
21. The left kidney is usually slightly higher than the right one. T F
22. Blood flows through the kidney at varying intervals. T F

Go with the Flow

Put the following steps, which describe the flow of urine, in order by placing the letters a through g in the space provided.

23. Urine flows from the ureters into the bladder. _____
24. Fluid collects in the Bowman's capsule. _____
25. Urine flows through the renal tubules to ducts in the kidney. _____
26. Urine exits the body. _____
27. Urine flows from the bladder to the urethra. _____
28. Urine flows from the kidneys into the ureter. _____
29. Fluid flows from the Bowman's capsule to the renal tubule. _____

Combining Forms and Abbreviations

The lists below include combining forms and abbreviations that relate specifically to the urinary system. Pronunciations are provided for the examples.

Combining Form	Meaning	Example
cali(o), calic(o)	calix	*calioplasty* [KĂ-lē-ō-plăs-tē], surgical reconstruction of a calix
cyst(o)	bladder, especially the urinary bladder	*cystitis* [sĭs-TĪ-tĭs], bladder inflammation
glomerul(o)	glomerulus	*glomerulitis* [glō-MĂR-yū-LĪ-tĭs], inflammation of the glomeruli
meat(o)	meatus	*meatotomy* [mē-ă-TŎT-ō-mē], surgical enlargement of the meatus

Combining Form	Meaning	Example
nephr(o)	kidney	*nephritis* [nĕ-FRĪ-tĭs], kidney inflammation
pyel(o)	renal pelvis	*pyeloplasty* [PĪ-ĕ-lō-plăs-tē], surgical repair of the renal pelvis
ren(o)	kidney	*renomegaly* [RĒ-nō-MĔG-ă-lē], enlargement of the kidney
trigon(o)	trigone	*trigonitis* [TRĪ-gō-NĪ-tĭs], inflammation of the trigone of the bladder
ur(o), urin(o)	urine	*uremia* [yū-RĒ-mē-ă], excess of urea and other nitrogenous wastes in the blood
ureter(o)	ureter	*ureterostenosis* [yū-RĒ-tĕr-ō-stĕ-NŌ-sĭs], narrowing of a ureter
urethr(o)	urethra	*urethrorrhea* [yū-rē-thrō-RĒ-ă], abnormal discharge from the urethra
-uria	of urine	*anuria* [ăn-yū-RĒ-ă], lack of urine formation
vesic(o)	bladder, generally used when describing something in relation to a bladder	*vesicoabdominal* [VĔS-ĭ-kō-ăb-DŎM-ĭ-năl], relating to the urinary bladder and the abdominal wall

Abbreviation	Meaning	Abbreviation	Meaning
ADH	antidiuretic hormone	**IVP**	intravenous pyelogram
A/G	albumin/globulin	**K+**	potassium
AGN	acute glomerulonephritis	**KUB**	kidney, ureter, bladder
ARF	acute renal failure	**Na+**	sodium
BNO	bladder neck obstruction	**pH**	power of hydrogen concentration
BUN	blood urea nitrogen	**PKU**	phenylketonuria
CAPD	continuous ambulatory peritoneal dialysis	**RP**	retrograde pyelogram
Cath	catheter	**SG**	specific gravity
CRF	chronic renal failure	**UA**	urinalysis
ESRD	end-stage renal disease	**UTI**	urinary tract infection
ESWL	extracorporeal shock wave lithotripsy	**VCU, VCUG**	voiding cystourethrogram
HD	hemodialysis		

CASE STUDY

Using Tests for Diagnosis

Dr. Chorzik ordered a urinalysis for two of his patients. The results give some clues to a possible diagnosis (see chart below and on p. 299). Note that the column marked Flag indicates when something is out of the range of normal. The reference column gives the normal ranges, and the results column gives the actual readings for the patients' tests. A clean catch urine test is one in which the urine is collected once the area has been cleaned and some urine has been excreted first.

Critical Thinking

30. Whose tests had the most abnormal readings?

31. Spell out at least three of the items being tested for.

Dr. Joel Chorzik
1420 Glen Road
Meadowvale, OK 44444
111-222-3333

Run Date: 09/22/XX
Run Time: 1507

Page 1
Specimen Report

Patient: James Delgado	Acct #: A994584732	Loc: ED	U #:
Reg Dr: S. Anders, M.D.	Age/Sx: 55/M	Room:	Reg: 09/22/XX
	Status: Reg ER	Bed:	Des:

Spec #: 0922 : U0009A	Coll: 09/22/XX	Status: Comp	Req #: 77744444
	Recd.: 09/22/XX	Subm Dr:	
Entered: 09/22/XX–0841		Other Dr:	
Ordered: UA with micro			
Comments: Urine Description: Clean catch urine			

Test	Result	Flag	Reference
Urinalysis			
UA with micro			
COLOR	YELLOW		
APPEARANCE	HAZY	**	
SP GRAVITY	1.018		1.001-1.030
GLUCOSE	NORMAL		NORMAL mg/dl
BILIRUBIN	NEGATIVE		NEG
KETONE	NEGATIVE		NEG mg/dl
BLOOD	2+	**	NEG
PH	5.0		4.5-8.0
PROTEIN	TRACE	**	NEG mg/dl
UROBILINOGEN	NORMAL		NORMAL-1.0 mg/dl
NITRITES	NEGATIVE		NEG
LEUKOCYTES	2+	**	NEG
WBC	20-50	**	0-5 /HPF
RBC	2-5		0-5 /HPF
EPI CELLS	20-50		/HPF
BACTERIA	2+	**	
MUCUS			

Patient 1

COMBINING FORMS AND ABBREVIATIONS EXERCISES

Build Your Medical Vocabulary

Complete the words by adding combining forms, suffixes, or prefixes you have learned in this chapter and in Chapters 1, 2, and 3.

32. Lack of urination: _____urea.

33. Inflammation of the renal pelvis: _____itis

CASE STUDY

Dr. Joel Chorzik
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111-222-3333

Run Date: 09/22/XX
Run Time: 1507

Page 1
Specimen Report

Patient: Sarah Margolis
Reg Dr: S. Anders, M.D.

Acct #: E005792849
Age/Sx: 45/F
Status: Reg ER

Loc:
Room:
Bed:

U #:
Reg: 09/22/XX
Des:

Spec #: 0922 : U00010R
Coll: 09/22/XX
Recd.: 09/22/XX
Status: Comp
Subm Dr:
Req #: 00704181

Entered: 09/22/XX–0936
Ordered: UA with micro
Other Dr:
Comments: Urine Description: Clean catch urine

Test	Result	Flag	Reference
Urinalysis			
UA with micro			
COLOR	BROWNISH	***	
APPEARANCE	HAZY	***	
SP GRAVITY	1.017		1.001-1.030
GLUCOSE	NORMAL		NORMAL mg/dl
BILIRUBIN	NEGATIVE		NEG
KETONE	NEGATIVE		NEG mg/dl
BLOOD	TRACE	**	NEG
PH	5.0		4.5-8.0
PROTEIN	NEGATIVE		NEG mg/dl
UROBILINOGEN	NORMAL		NORMAL-1.0 mg/dl
NITRITES	NEGATIVE		NEG
LEUKOCYTES	NEGATIVE		NEG
WBC	NO CELLS		0-5 /HPF
RBC	2-5		0-5 /HPF
EPI CELLS	0-2		/HPF
MUCUS	1+		

Patient 2

34. Excessive urination: _____uria
35. Kidney disease: _____pathy
36. Scanty urination: _____
37. Bladder paralysis: olig_____plegia
38. Lipids in the urine: lip_____
39. Abnormally large bladder: mega_____
40. Relating to the bladder and the urethra: vesico_____al
41. Kidney enlargement: reno_____
42. Inflammation of the tissues surrounding the bladder: _____cystitis
43. Medical specialty concerned with kidney disease: _____logy
44. Inflammation of the renal pelvis and other kidney parts: pyelo_____itis
45. Suturing of a calix: calio_____
46. Between the two kidneys: inter_____
47. Abnormal urethral discharge: urethro_____
48. Hemorrhage from a ureter: _____rrhagia

49. Softening of the kidneys: nephro_____

50. Within the urinary bladder: _____cystic

51. Removal of a kidney stone: _____litho_____

52. Imaging of the kidney: _____graphy

53. Kidney-shaped: reni_____

Root Out the Meaning

Divide the following words into parts. Write the urinary combining forms in the space at the right and define the word shown.

54. glomuleronephritis
55. nephrocystosis
56. urethrostenosis
57. ureterovesicostomy
58. urocyanosis
59. urolithology
60. pyeloureterectasis
61. calicotomy
62. cystolithotomy
63. nephroma
64. meatorrhaphy
65. nephrosclerosis
66. renopulmonary
67. trigonitis

Find the Right Words

Define the following abbreviations.

68. ADH
69. pH
70. CAPD
71. VCU
72. HD
73. PKU
74. BUN
75. KUB
76. ESWL
77. UTI
78. RP

Reviewing Word Parts

Write the letter of the correct definition in the space provided. Letters may be used more than once or not at all.

79. ____ ur(o)
80. ____ ureter
81. ____ –uria
82. ____ ren(o)
83. ____ meat(o)
84. ____ nephr(o)
85. ____ pyel(o)_
86. ____ cyst(o)
87. ____ urin(o)
88. ____ vesic(o)

a. many
b. flowing
c. urine
d. bladder
e. enlargement
f. bladder
g. renal pelvis
h. kidney
i. opening
j. tube from kidney to bladder

89. ____ –megaly
90. ____ -rrhea
91. ____ oligo-
92. ____ poly-
93. ____ –itis

k. inflammation
l. scanty
m. blood
n. urethra
o. nephron

Building Words

Complete each of the following urinary terms by putting a word part in the blank.

94. bladder inflammation: cyst_____.
95. removal of a kidney: _____ectomy.
96. hernia in the bladder: _____cele.
97. blood in the urine: hemat_____.
98. common urinary test: _____alysis.
99. bladder tumor: cyst_____.
100. enlargement of the kidneys: nephro_____.

Diagnostic, Procedural, and Laboratory Terms

Specialists in the urinary system are *urologists*, who treat disorders of the male and female urinary tracts and the male reproductive system, and *nephrologists*, who treat disorders of the kidneys. **Urinalysis** is the most common diagnostic and laboratory test of the urinary system. It involves the examination of urine for the presence of normal or abnormal amounts of various elements. Substances in the urine are a prime factor in the diagnosis of diseases of the urinary system as well as of other body systems. In addition, various imaging and blood tests help diagnose conditions or diseases.

Urinalysis

Urinalysis is the examination of urine for its physical and chemical and microscopic properties (Figure 9-6). Urine is gathered from clients who fill a specimen bottle by themselves or whose urine is obtained by *urinary catheterization*, the insertion of a flexible tube through the meatus and into the urinary bladder. Some patients do not have bladder control or may have certain conditions that require catheters to aid in urination. A **Foley catheter** (Figure 9-7) is **indwelling** (left in the bladder) and is held in place by a balloon inflated in the bladder. Foley catheters are also known as *retention catheters*. Other types of catheters may be disposable units. **Condom catheters** (also called *Texas catheters*, *external urinary drainage* [*EUD*] *catheters*, or *latex catheters*) are changed at least once a day (Figure 9-8). A condom catheter consists of a rubber sheath placed over the penis with tubing connected to a drainage or leg bag where the urine collects.

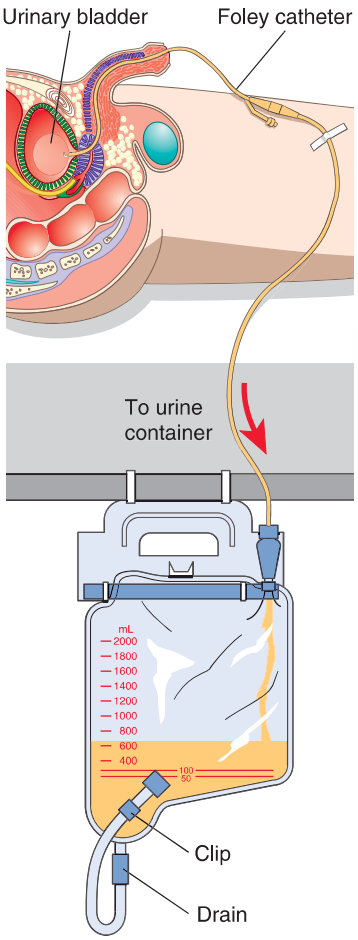

FIGURE 9-7 A Foley catheter remains in place; the collection bag is drained and cleaned.

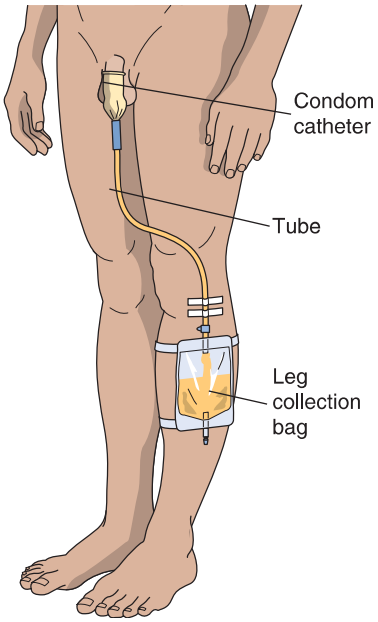

FIGURE 9-8 A condom catheter is changed daily.

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Run Date: 02/22/XX
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Specimen Report

Patient: Maria Bozutti
Reg Dr: S. Anders, M.D.

Acct #: C038642
Age/Sx: 28/F
Status: Reg ER

Loc:
Room:
Bed:

U #:
Reg: 02/22/XX
Des:

Spec #: 0222 : U00022

Coll: 02/22/XX
Recd.: 02/22/XX

Status: Comp
Subm Dr:

Req #: 77744590

Entered: 02/22/XX–0841
Ordered: UA with micro
Comments: Urine Description: Clean catch urine

Other Dr:

Test	Result	Flag	Reference
Urinalysis			
UA with micro			
COLOR	YELLOW		
APPEARANCE	HAZY		
SP GRAVITY	1.018		1.001-1.030
GLUCOSE	2.604	***	NORMAL mg/dl
BILIRUBIN	NEGATIVE		NEG
KETONE	NEGATIVE		NEG mg/dl
BLOOD	NEGATIVE		NEG
PH	5.0		4.5-8.0
PROTEIN	NEGATIVE		NEG mg/dl
UROBILINOGEN	NORMAL		NORMAL-1.0 mg/dl
NITRITES	NEGATIVE		NEG
LEUKOCYTES	NEGATIVE		NEG
WBC	3		0-5 /HPF
RBC	3.5		0-5 /HPF
EPI CELLS	20-50		/HPF
BACTERIA	NEGATIVE		
MUCUS			

FIGURE 9-6 Urinalysis is a crucial diagnostic test. Dissolved wastes in the urine may reveal any of a number of diseases. For example, in the test results shown here, the patient's glucose is higher than normal, indicating possible diabetes.

There are three phases of a complete urinalysis:

1. The first phase is the *macroscopic* or *physical phase*. During this phase, the color, turbidity (cloudiness caused by suspended sediment), and **specific gravity** (ratio of density of a substance) of urine give certain diagnostic clues. Normal urine is straw-colored and clear. Blood in the urine may darken it, or show up clearly as blood. Pus or infection may make the urine cloudy. Low specific gravity may indicate kidney disease, and high specific gravity may indicate diabetes.
2. The second phase is the *chemical phase*, which determines what chemicals are present in the urine. It also determines the **pH** range of urine. The normal pH range is from 5 to 7. A reading above 7 indicates alkaline urine; a reading below 7 indicates acid urine. Alkaline urine may indicate the presence of an infection. Acidic urine controls the bacteria

MORE ABOUT . . .

Drug Testing

Drug testing by employers is fairly routine, especially for large corporations. However, drug testing in schools is a controversial practice. The Supreme Court has allowed the testing in certain circumstances.

entering the urethra. High uric acid may indicate gout, a metabolic disorder.

3. The third phase is the *microscopic phase* during which urine sediment is examined for solids (including cellular material) or **casts,** which are formed when protein accumulates in the urine. This may indicate the presence of kidney disease. The casts are often composed of pus or fats. The amount of wastes, minerals, and solids in urine is measured as the specific gravity.

Appendix E gives the chemical analyses and ranges commonly used in urinalysis.

In addition, tests of urine are designed to detect various substances indicative of specific conditions. The presence of high quantities of **acetones** usually occurs in diabetes. **Ketones** in the urine may indicate starvation or diabetes. Ketones in the urine can lead to dangerously high levels of acid in the blood, a potential cause of coma and/or death. The presence of the serum protein **albumin** in urine may indicate a leakage of blood proteins through the renal tubules, an indicator of *nephron disease*. **Glucose** in the urine usually indicates diabetes. Pus in the urine makes the urine cloudy and indicates an infection or inflammation in the urinary system. Bacteria in the urine elevates the nitrite result on the urinalysis. This indicates a urinary tract infection. Blood in the urine usually indicates bleeding in the urinary tract. Calcium in the urine is abnormal and indicates one of several conditions, such as rickets. **Bilirubin** in the urine indicates liver disease, such as obstructive disease of the biliary tract and liver cancer.

Blood Tests

Two important blood tests of kidney function are the *blood urea nitrogen* (*BUN*) and the *creatinine clearance test*. The presence of high amounts of urea or creatinine in the kidney shows that the kidney is not filtering and removing these toxic substances from the blood. If this is not treated and kidney failure persists, death may result.

Phenylketones in the blood show a lack of an important enzyme that can lead to mental retardation in infants unless a strict diet is followed into adulthood. Infants are routinely tested for this deficiency at birth by taking a blood sample (using a heel stick), which is analyzed for presence of the enzyme.

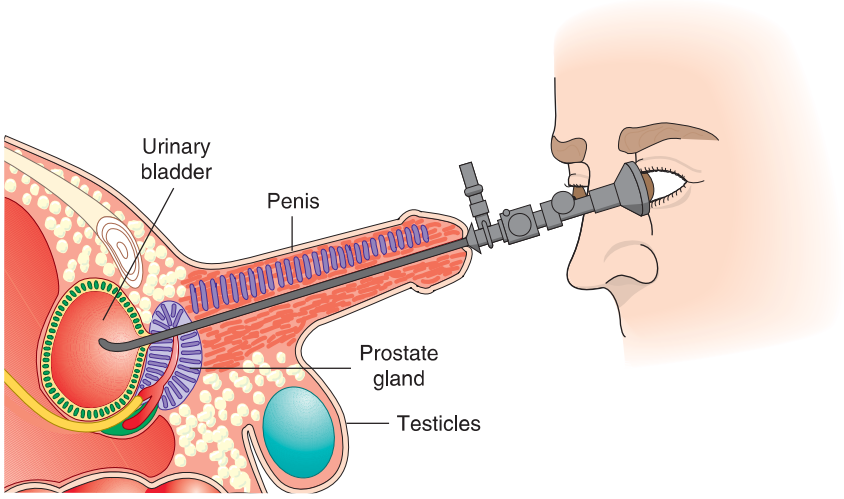

FIGURE 9-9 Using a cystoscope, a urologist can view the inside of the urinary bladder.

Imaging Tests

Various tests are used to visually diagnose stones, growths, obstructions, or abnormalities in the urinary system. A **cystoscopy** is the insertion of a tubular instrument (a **cystoscope**) to examine the bladder with a light (Figure 9-9). An *intravenous pyelogram* (*IVP*) and an *intravenous urogram* are x-rays of the urinary tract after a contrast medium is injected into the bloodstream. A **kidney, ureter, bladder (KUB)** is an x-ray of three parts of the urinary tract. A *renal angiogram* is an x-ray of the renal artery after a contrast medium is injected into the artery. A **retrograde pyelogram (RP)** is an x-ray of the kidney, bladder, and ureters taken after a cystoscope is used to introduce a contrast medium. A **voiding (urinating) cystourethrogram (VCU, VCUG)** is an x-ray taken during urination to examine the flow of urine through the system. An *abdominal sonogram* is the production of an image of the urinary tract using sound waves.

Radioactive imaging is also used to diagnose kidney disorders via a renal scan. A **renogram** is used to study kidney function.

FIGURE 9-10 Hemodialysis is the removal of waste from the bloodstream by passing blood through a filtering machine.

Urinary Tract Procedures

Certain procedures, particularly **dialysis,** can mechanically maintain kidney or renal function when kidney failure occurs. **Hemodialysis** is the process of filtering blood outside the body in an artificial kidney machine and returning it to the body after filtering (Figure 9-10). **Peritoneal dialysis** is the insertion and removal of a dialysis solution into the peritoneal cavity (Figure 9-11). The action of this type of dialysis causes the wastes in the capillaries of the peritoneum to be released and drained out of the body. Peritoneal dialysis is used for patients who are able to have dialysis while ambulatory. The patient attaches a bag containing the dialysis solution to an opening in the peritoneum and fills the peritoneal cavity. The fluid is retained for several hours. During that time, waste products will move from the blood into the fluid through osmosis. Once empty, the bag is removed and replaced by a drainage bag into which the solution flows gradually.

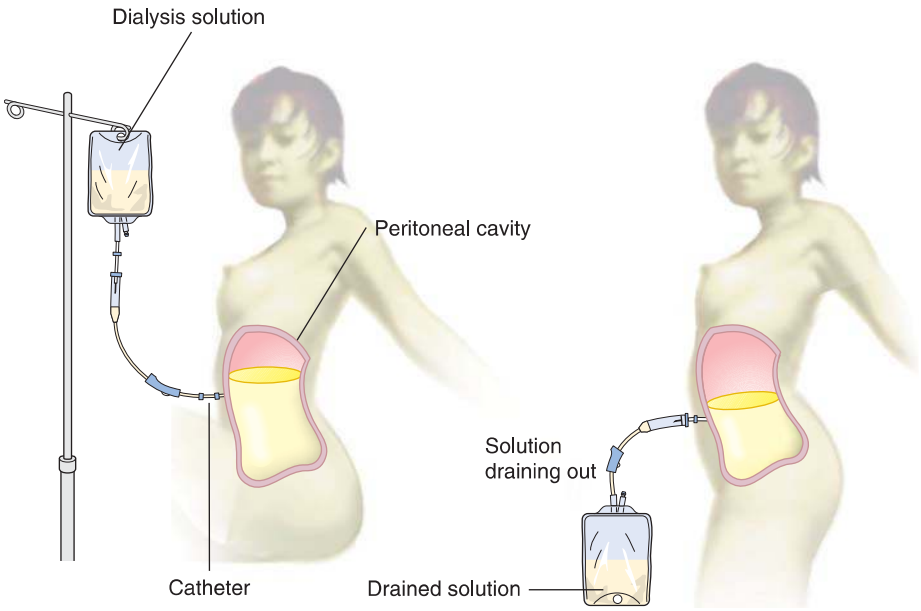

FIGURE 9-11 In peritoneal dialysis, the inserted fluid stays in the peritoneal cavity for about 6 hours until it is drained out through the opening in the peritoneum.

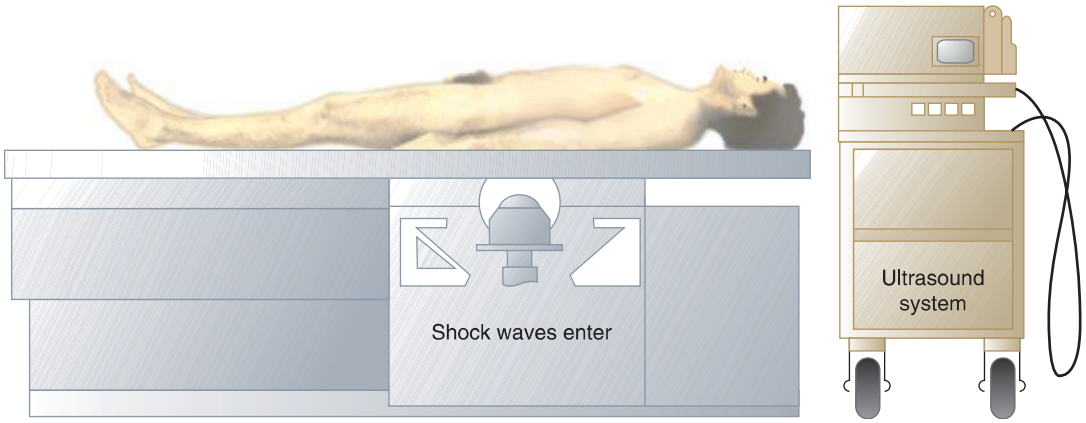

FIGURE 9-12 ESWL is the use of shock waves to break up urinary stones.

Extracorporeal shock wave lithotripsy (ESWL) is the breaking up of urinary stones by using shock waves from outside the body. Figure 9-12 shows a patient undergoing this procedure. The stones are broken into fragments that can then pass through the urine. This procedure is often used for kidney stones. There are other methods for treating stones or *calculi*. Some involve surgery; others involve medication and/or waiting for smaller stones to pass through the urinary tract.

Vocabulary Review

In the previous section, you learned terms relating to diagnosis, clinical procedures, and laboratory tests. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
acetone [ĂS-ĕ-tōn]	Type of ketone normally found in urine in small quantities; found in larger quantities in diabetic urine.
albumin [ăl-BYŪ-mĭn] Latin *albumen*, egg white	Simple protein; when leaked into urine, may indicate a kidney problem.
bilirubin [bĭl-ĭ-RŪ-bĭn] bil(e) + Latin *ruber*, red	Substance produced in the liver; elevated levels may indicate liver disease or hepatitis when found in urine.
casts	Materials formed in urine when protein accumulates; may indicate renal disease.
condom catheter [KŎN-dŏm KĂTH-ĕ-tĕr]	Disposable catheter for urinary sample collection or incontinence.
cystoscope [SĬS-tō-skōp] cysto-, bladder + -scope, instrument for viewing	Tubular instrument for examining the interior of the bladder.
cystoscopy [sĭs-TŎS-kō-pē] cysto- + -scopy, use of an instrument for viewing	The insertion of a cystoscope to examine the bladder with light.
dialysis [dī-ĂL-ĭ-sĭs] Greek, a separation	Method of filtration used when kidneys fail.
extracorporeal shock wave lithotripsy [ĔKS-tră-kōr-PŌR-ē-ăl shŏk wāv LĪTH-ō-trĭp-sē] **(ESWL)**	Breaking of kidney stones by using shock waves from outside the body.
Foley [FŌ-lē] **catheter** After F. E. B. Foley (1891–1966), American urologist	Indwelling catheter held in place by a balloon that inflates inside the bladder.
glucose [GLŪ-kōs] Greek *gleukos*, sweetness	Form of sugar found in the blood; may indicate diabetes when found in the urine.
hemodialysis [HĒ-mō-dī-ĂL-ĭ-sĭs] hemo-, blood + dialysis	Dialysis performed by passing blood through a filter outside the body and returning filtered blood to the body.
indwelling [ĬN-dwĕ-lĭng] in + dwelling	Of a type of catheter inserted into the body.
ketone [KĒ-tōn]	Substance that results from the breakdown of fat; indicates diabetes or starvation when present in the urine.
kidney, ureter, bladder (KUB)	X-ray of three parts of the urinary system.
peritoneal [PĔR-ĭ-tō-NĒ-ăl] **dialysis**	Type of dialysis in which liquid that extracts substances from blood is inserted into the peritoneal cavity and later emptied outside the body.
pH	Measurement of the acidity or alkalinity of a solution such as urine.
phenylketones [FĔN-ĭl-KĒ-tōns]	Substances that, if accumulated in the urine of infants, indicate phenylketonuria (PKU), a disease treated by diet.

Term	Definition
renogram [RĒ-nō-grăm] reno-, kidney + -gram, a recording	Radioactive imaging of kidney function after introduction of a substance that is filtered through the kidney while it is observed.
retrograde pyelogram [RĔT-rō-grād PĪ-ĕl-ō-grăm] **(RP)**	X-ray of the bladder and ureters after a contrast medium is injected into the bladder.
specific gravity	Measurement of the concentration of wastes, minerals, and solids in urine.
urinalysis [yū-rĭ-NĂL-ĭ-sĭs] urin-, urine + (an)alysis	Examination of the properties of urine.
voiding (urinating) cystourethrogram [sĭs-tō-yū-RĒ-thrō-grăm] **(VCU, VCUG)**	X-ray image made after introduction of a contrast medium and while urination is taking place.

CASE STUDY

Examining the Symptoms

Ms. Jones is a 77-year-old female who complained to Dr. Chorzik of painful, scanty, and frequent urination for the past two days. She says that she normally drinks 7 to 8 glasses of water a day, but lately has cut down because of the frequent urination. Her urine was cloudy with a strong odor.

Critical Thinking

101. What did the cloudy urine most likely indicate?

102. What might be present in cloudy urine to indicate infection?

DIAGNOSTIC, PROCEDURAL, AND LABORATORY TERMS EXERCISES

Find the Test

In the space provided, put Y for those properties or substances tested for in urinalysis and N for those substances that are not tested for in urinalysis.

103. glucose _____

104. sodium _____

105. albumin _____

106. cholesterol _____

107. protein _____

108. lipids _____

109. specific gravity _____

110. pH _____

111. bilirubin _____

112. acetone _____

113. phenylketones _____

114. ketones _____

115. homocysteine _____

Finish the Thought

Fill in the blanks.

116. Removing wastes from the blood outside the body is called _____.

117. Removing wastes from the peritoneal cavity using a portable apparatus is called _____ _____.

118. A type of indwelling catheter is (n) _____ catheter.

119. A catheter changed at least once a day is called a(n)_____ _____ catheter.

120. Two substances found in the urine that may indicate diabetes are _____ and _____.

121. Lithotripsy is used to break up _____ that have formed.

122. Solids found in urine are called _____.

123. Dialysis is a method of _____ used in _____ failure.

124. Kidney disorders may be diagnosed by blood tests such as the _____ _____ _____ or _____ _____ _____.

125. An x-ray image taken during urination is a(n) _____ _____.

Pathological Terms

The National Kidney and Urologic Diseases Information Clearinghouse gives facts about UTI prevention and treatment on their Web site (http://kidney.niddk.nih.gov/kudiseases/pubs/utiadult/index.htm).

Infections can occur anywhere in the urinary tract. A **urinary tract infection (UTI)** commonly refers to a bladder or urethra infection. Symptoms include painful and frequent urination and a general feeling of malaise (general discomfort). Treatment generally includes antibiotics. Fully emptying the bladder during urination, emptying the bladder after intercourse, adequate water intake, and careful maintenance of cleanliness around the urethra can help in preventing UTIs.

Some additional photos of interesting kidney stones can be seen at http://www.herringlab.com/photos/.

Hardened lumps of matter (*calculi* or *stones*) tend to form in the kidneys and other parts of the urinary system. The stone may cause bleeding that shows up as blood in the urine. Stones can be extremely painful. If possible, the stones are allowed to pass into the urine; otherwise, lithotripsy (the use of sound waves aimed at the stone to break it up) or surgery may be required. The patient's urine is then filtered through something (such as gauze) that retains the solid material. The solid material is analyzed for content, and a diet or medication is prescribed to prevent the occurrence of further stones. Kidney stones are also known as *nephrolithiasis*.

A number of infections and inflammations affect the urinary system. **Nephritis** is the general term for inflammation of the kidney. **Glomerulonephritis** refers to a kidney inflammation located in the glomeruli. This inflammation, known as **Bright's disease,** can be acute, as after a systemic infection, or may become chronic. When chronic, high blood pressure, kidney failure, and other conditions can result. *Interstitial nephritis* is an inflammation of the

connective tissue between the renal tubules. **Pyelitis** is an inflammation of the renal pelvis. *Pyelonephritis* is a bacterial infection in the renal pelvis with abscesses.

Nephrosis or *nephrotic syndrome* is a group of symptoms usually following or related to another illness that causes protein loss in the urine **(proteinuria)**. **Edema** (swelling) may result from this syndrome. Such swelling may adversely affect blood pressure. **Hydronephrosis** is the collection of urine in the kidneys without release due to a blockage. **Polycystic kidney disease** is a progressive, hereditary condition in which numerous kidney cysts form that can cause other conditions in adults, such as high blood pressure and excess blood and waste in the urine.

Renal hypertension may result from other kidney or systemic diseases. **Kidney** (*renal*) **failure,** the loss of kidney function, may result from other conditions—some chronic, such as diabetes, and some acute, such as a kidney infection. Kidney failure can be treated with dialysis and medications. **Uremia** and **azotemia,** excesses of urea and other nitrogenous wastes in the blood, may result from kidney failure. **End-stage renal disease (ESRD)** is severe, and fatal if not treated. *Renal cell carcinoma* or kidney cancer is usually treated by surgery. **Wilms' tumor** or a **nephroblastoma** is a malignant tumor of the kidneys found primarily in children. It is usually treated with surgery, radiation, and chemotherapy. A **nephroma** is any renal tumor.

Cystitis is an inflammation of the bladder. Aside from urinary tract infections, the bladder may be the site of **bladder cancer.** Various tumors can be removed or treated. In cases of extensive malignancy, the bladder may need to be surgically removed. Other bladder problems include a **cystocele,** a hernia of the bladder, and a **cystolith,** a stone in the bladder.

Inflammations can also occur in the urethra (*urethritis*), the urethra and bladder together (*urethrocystitis*), or the ureters (*ureteritis*). *Urethral stenosis* is a narrowing of the urethra that causes voiding difficulties.

Difficulties in urination are often a symptom of another systemic disease, such as diabetes, or a localized infection (UTI). Such difficulties can include no urine output **(anuria)**, painful urination **(dysuria),** lack of bladder control **(enuresis,** including *nocturnal enuresis*, nighttime bed-wetting), frequent nighttime urination **(nocturia)**, scanty urination **(oliguria)**, excessive urination **(polyuria)**, or urination during sneezing or coughing (*stress incontinence*). The general term **incontinence** refers to the involuntary discharge of urine or feces.

Abnormal substances or specific levels of substances in the urine indicate either urinary tract disorders or systemic disorders. Some can be minor infections or major problems. **Albuminuria** or *proteinuria* indicates the presence of albumin in the urine; **hematuria** indicates the presence of blood in the urine. **Ketonuria** indicates the presence of ketone bodies in the urine. **Pyuria** indicates the presence of pus and white blood cells in the urine.

Diabetes is a name for several metabolic diseases that both affect, and are diagnosed, in part, through observation of, the urinary system. Diabetes is covered in detail in Chapter 15.

Many congenital problems can occur in the urinary system. Surgery can correct many of these. *Hypospadias* is a congenital problem and is discussed in Chapters 10 and 11. It is a defect in which the urinary meatus opens at a place other than the distal end of the penis in males or between the clitoris and vagina in females. **Atresia** (narrowing) of the ureters or urethra may also be present at birth.

MORE ABOUT . . .

Bed-wetting

Some children, particularly boys, may wet their beds at night (a condition called *nocturnal enuresis*) up to their teenage years. For years, parents have tried everything from humiliation and restricting fluids, to some sort of shock therapy, such as awakening with a loud sound. Most of these methods have not worked. Usually the problem resolves by itself by the teenage years or earlier. In most cases, the children are found to have immature development of the urinary tract, allergies, or such sound sleep habits that they are unable to awaken. Medications are now available to control or treat enuresis.

VOCABULARY REVIEW

In the previous section, you learned terms relating to pathology. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
albuminuria [ăl-byū-mĭ-NŪ-rē-ă] albumin + -uria, urine	Presence of albumin in urine, usually indicative of disease.
anuria [ăn-YŪ-rē-ă] an- + -uria	Lack of urine formation.
atresia [ă-TRĒ-zhē-ă] a-, without + Greek *tresis*, hole	Abnormal narrowing, as of the ureters or urethra.
azotemia [ăz-ō-TĒ-mē-ă] French *azote*, nitrogen + -emia, blood	*See* uremia.
bladder cancer	Malignancy of the bladder.
Bright's disease After Richard Bright (1789–1858), English internist	Inflammation of the glomeruli that can result in kidney failure.
cystitis [sĭs-TĪ-tĭs] cyst-, bladder + -itis, inflammation	Inflammation of the bladder.
cystocele [SĬS-tō-sēl] cysto-, bladder + -cele, hernia	Hernia of the bladder.
cystolith [SĬS-tō-lĭth] cysto- + -lith, stone	Bladder stone.
dysuria [dĭs-YŪ-rē-ă] dys-, difficult + -uria	Painful urination.
edema [ĕ-DĒ-mă] Greek *oidema*, a swelling	Retention of water in cells, tissues, and cavities, sometimes due to kidney disease.
end-stage renal disease (ESRD)	The last stages of kidney failure.
enuresis [ĕn-yū-RĒ-sĭs] Greek *enoureo*, to urinate in + -sis, condition	Urinary incontinence.

Term	Definition
glomerulonephritis [glō-MĀR-yū-lō-nĕf-RĪ-tĭs] glomerulo-, glomerulus + nephr-, kidney + -itis	Inflammation of the glomeruli of the kidneys.
hematuria [hē-mă-TŪ-rē-ă] hemat-, blood + -uria	Blood in the urine.
hydronephrosis [HĪ-drō-nĕ-FRŌ-sĭs] hydro-, water + nephr-+ -osis, condition	Abnormal collection of urine in the kidneys due to a blockage.
incontinence [ĭn-KŎN-tĭ-nĕns] From in-, not + Latin *contineo*, to hold together	Inability to prevent excretion of urine or feces.
ketonuria [kē-tō-NŪ-rē-ă] keton(e) + -uria	Increased urinary excretion of ketones, usually indicative of diabetes or starvation.
kidney failure	Loss of kidney function.
nephritis [nĕ-FRĪ-tĭs] nephr- + -itis	Inflammation of the kidneys.
nephroblastoma [NĔF-rō-blăs-TŌ-mă] nephro-, kidney + blastoma	*See* Wilms' tumor.
nephroma [nĕ-FRŌ-mă] nephr- + -oma, tumor	Any renal tumor.
nephrosis [nĕ-FRŌ-sĭs] nephr- + -osis	Disorder caused by loss of protein in the urine.
nocturia [nŏk-TŪ-rē-ă] noct-, night + -uria	Frequent nighttime urination.
oliguria [ŏl-ĭ-GŪ-rē-ă] olig-, scant + -uria	Scanty urine production.
polycystic [pŏl-ē-SĬS-tĭk] **kidney disease**	Condition with many cysts on and within the kidneys.
polyuria [pŏl-ē-ŪR-ē-ă] poly-, much + -uria	Excessive urination.
proteinuria [prō-tē-NŪ-rē-ă] protein + -uria	Abnormal presence of protein in the urine.
pyelitis [pī-ĕ-LĪ-tĭs] pyel-, pelvis + -itis	Inflammation of the renal pelvis.
pyuria [pī-YŪ-rē-ă] py-, pus + -uria	Pus in the urine.
uremia [yū-RĒ-mē-ă] ur-, urine + -emia, blood	Excess of urea and other nitrogenous wastes in the blood.
urinary tract infection (UTI)	Infection of the urinary tract.
Wilms' [vĭlmz] **tumor** After Max Wilms (1867–1918), German surgeon	Malignant kidney tumor found primarily in young children; nephroblastoma.

Pathological Terms Exercises

Build Your Medical Vocabulary

Using the combining forms in this chapter, complete the names of the disorders.

126. Inflammation of the urethra: _____ itis

127. Inflammation of the ureter: _____ itis

128. Inflammation of the bladder and urethra: _____ itis

129. Inflammation of the kidneys: _____ itis

130. Tumor in the kidneys: _____ oma

Spell It Correctly

Check the spelling of the following words. Write C if the spelling is correct. If it is incorrect, write the correct spelling in the space provided.

131. ureteritis _____

132. cystitis_____

133. dysuria_____

134. urethеritis_____

135. cytorrhaphy_____

Check Your Knowledge

Circle T for true or F for false.

136. Wilms' tumor is found only in middle-aged adults. T F

137. Urine collects in the renal pelvis. T F

138. Edema is swelling that may be due to kidney disease. T F

139. Oliguria is abnormally high production of urine. T F

140. Anuresis means the same as enuresis. T F

CASE STUDY

Seeing a Specialist

Mr. Delgado had a fairly normal urinalysis, but restricted urination indicated some other urinary tract problem. Dr. Chorzik referred Mr. Delgado to a urologist. Ms. Margolis had blood in her urine and some signs of infection. Ms. Jones had pus in her urine, and it was cloudy. She had complained about painful, scanty, and excessive urination at various times. Dr. Chorzik concluded that she had a urinary tract infection.

Critical Thinking

141. What are the medical terms for the symptoms Ms. Jones experienced?

142. What course of treatment will likely be prescribed for Ms. Jones?

Surgical Terms

Urology is the practice of medicine specializing in the urinary tract. The practitioner is called a urologist. Urologists diagnose, treat, and perform surgery on the urinary system in the female and on the urinary and reproductive system in the male.

Parts of the urinary system may be surgically removed. A person can live with only one kidney, so a diseased kidney may be removed in a **nephrectomy.** Diseased kidneys are removed before a *kidney* or *renal transplant*. Other

surgical procedures on the kidney include **nephrolysis,** the removal of adhesions in the kidney; **nephrostomy,** the creation of an opening in the kidney leading to the outside of the body; **nephrolithotomy,** surgical removal of a kidney stone; **nephropexy,** surgical affixing in place of a floating kidney; and **nephrorrhaphy,** suturing of a damaged kidney.

An incision into the renal pelvis is called a **pyelotomy.** A **pyeloplasty** is the surgical repair of the renal pelvis. Surgical repair of a ureter is **ureteroplasty. Ureterorrhaphy** is the suture of a damaged ureter. **Ureterectomy** is the surgical removal of a diseased ureter.

The urinary bladder can be the site of stones, which are removed during a **lithotomy.** A **cystectomy** is the removal of the bladder (usually when cancer is present). Surgical fixing of the bladder to the abdominal wall is **cystopexy,** an operation to help correct urinary incontinence. **Cystoplasty** is the surgical repair of a bladder, and **cystorrhaphy** is the suturing of a damaged bladder.

The urethra may also need surgical repair (**urethroplasty**), surgical fixation (**urethropexy**), or suturing (**urethrorrhaphy**). A **urethrostomy** is the surgical creation of an opening between the urethra and the skin, while a **meatotomy** is the surgical enlargement of the opening of the meatus. Either of these operations may be necessary when certain birth defects are present. A narrowing in the urethra may require a **urethrotomy,** a surgical incision to enlarge the narrowed area.

Sometimes an opening is made to bypass diseased parts of the urinary tract. A **urostomy** is the creation of an artificial opening in the abdomen through which urine exits the body. **Intracorporeal electrohydraulic lithotripsy** is the use of an endoscope, an instrument for examining an interior canal or cavity, to break up stones in the urinary tract. A **resectoscope** is an endoscope used to cut and remove lesions in parts of the urinary system. An instrument called a *stone basket* may be attached to an endoscope and used for retrieving stones through a body cavity.

Vocabulary Review

In the previous section, you learned terms relating to surgery. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Term	Definition
cystectomy [sĭs-TĔK-tō-mē] cyst-, bladder + -ectomy, removal	Surgical removal of the bladder.
cystopexy [SĬS-tō-pĕk-sĕ] cysto-, bladder +-pexy, fixing	Surgical fixing of the bladder to the abdominal wall.
cystoplasty [SĬS-tō-plăs-tē] cysto- + -plasty, repair	Surgical repair of the bladder.
cystorrhaphy [sĭs-TŌR-ă-fē] cysto- + -rrhaphy, suturing	Suturing of a damaged bladder.

Term	Definition
intracorporeal electrohyrdraulic lithotripsy [ĬN-tră-kōr-PŌ-rē-ăl ē-LĔK-trō-hī-DRŌ-lĭk LĬTH-ō-trĭp-sē]	Use of an endoscope to break up stones.
lithotomy [lĭ-THŎT-ō-mē] litho-, stone + -tomy, a cutting	Surgical removal of bladder stones.
meatotomy [mē-ă-TŎT-ō-mē] meat(us) + -tomy	Surgical enlargement of the meatus.
nephrectomy [nĕ-FRĔK-tō-mē] nephr-, kidney + -ectomy	Removal of a kidney.
nephrolithotomy [NĔF-rō-lĭ-THŎT- ō-mē] nephro-, kidney + litho-, stone + -tomy	Surgical removal of a kidney stone.
nephrolysis [nĕ-FRŎL-ĭ-sĭs] nephro- + -lysis, dissolving	Removal of kidney adhesions.
nephropexy [NĔF-rō-pĕk-sĕ] nephro- + -pexy	Surgical fixing of a kidney to the abdominal wall.
nephrorrhaphy [nĕf-RŌR-ă-fē] nephro- + -rrhaphy	Suturing of a damaged kidney.
nephrostomy [nĕ-FRŎS-tō-mē] nephro- + -stomy, opening	Establishment of an opening from the renal pelvis to the outside of the body.
pyeloplasty [PĪ-ĕ-lō-PLĂS-tē] pyelo-, pelvis + -plasty	Surgical repair of the renal pelvis.
pyelotomy [pī-ĕ-LŎT-ō-mē] pyelo- + -tomy	Incision into the renal pelvis.
resectoscope [rē-SĔK-tō-skōp] Latin *reseco*, to cut off + scope, instrument for viewing	Type of endoscope for removal of lesions.
ureterectomy [yū-rē-tĕr-ĔK-tō-mē] ureter + -ectomy	Surgical removal of all or some of a ureter.
ureteroplasty [yū-RĒ-tĕr-ō-PLĂS-tē] uretero-, ureter + -plasty	Surgical repair of a ureter.
ureterorrhaphy [yū-rē-tĕr-ŌR-ă-fē] uretero- + -rrhaphy	Suturing of a ureter.
urethropexy [yū-RĒ-thrō-pĕk-sē] urethro-, urethra + -pexy	Surgical fixing of the urethra.
urethroplasty [yū-RĒ-thrō-PLĂS-tē] urethro- + -plasty	Surgical repair of the urethra.
urethrorrhaphy [yū-rē-THRŌR-ă-fē] urethro- + -rrhaphy	Suturing of the urethra.
urethrostomy [yū-rē-THRŎS-tō-mē] urethro- + -stomy	Establishment of an opening between the urethra and the exterior of the body.
urethrotomy [yū-rē-THRŎT-ō-mē] urethro- + -tomy	Surgical incision of a narrowing in the urethra.
urology [yū-RŎL-ō-jē] uro-, urine + -logy, study of	Medical specialty that diagnoses and treats the urinary system and the male reproductive system.
urostomy [yū-RŎS-tō-mē] uro- + -stomy	Establishment of an opening in the abdomen to the exterior of the body for the release of urine.

CASE STUDY

Getting the Diagnosis

Patient #1: Mr. Delgado's appointment with the urologist was scheduled for the next day. During a physical examination, the urologist noticed some swelling in the prostate gland, but did not think this was enough to cause Mr. Delgado's difficulties. The urologist ordered a blood test (PSA) to determine if there were another possible cause. The PSA results were normal. The urologist then ordered imaging tests. One test showed a narrowing of the urethra.

Patient #2: Ms. Margolis, a 69-year-old female, had additional tests and was found to have serious kidney disease in one kidney. A nephrectomy was performed, and eventually her symptoms subsided.

Critical Thinking

143. What procedure might relieve Mr. Delgado's symptoms?

144. Ms. Margolis had one kidney removed. The other one is healthy. Does she need dialysis?

SURGICAL TERMS EXERCISES

Build Your Medical Vocabulary

Complete the name of the operation by adding one or more combining forms.

145. Removal of kidney stones: _____ tomy

146. Removal of kidney adhesions: _____ lysis

147. Removal of a kidney: _____ ectomy

148. Removal of a ureter: _____ ectomy

149. Creation of an artificial opening in the urinary tract: _____ stomy

Check Your Knowledge

Circle T for true or F for false.

150. Surgical repair of the urethra is ureteroplasty. T F

151. Several organs and structures in the urinary system may need surgical attaching to be held in position. T F

152. A resectoscope is an instrument used to remove lesions. T F

153. A urethrostomy and a urostomy serve the same function. T F

154. A cystopexy can help urinary incontinence. T F

Pharmacological Terms

Medications for the urinary tract can relieve pain (analgesics), relieve spasms (**antispasmodics**), or inhibit the growth of microorganisms (*antibiotics*). They may also increase (**diuretics**) or decrease (*antidiuretics*) the secretion of urine. Table 9-1 shows some common medications prescribed for urinary tract disorders.

TABLE 9-1 Some Common Medications Used to Treat the Urinary System

Drug Class	Purpose	Generic	Trade Name
analgesic	to relieve pain	phenazopyridine	Pyridium, Urogesic
antibiotic	to treat infections (especially UTIs) including ones with a fungal cause	trimethoprim amoxicillin tetracycline ciprofloxacin levofloxacin	Trimpex Amoxil, Wymox Sumycin Cipro Levaquin
antidiuretic	to control secretion of urine	vasopressin	Pitressin
antispasmodic	to relax muscles so as to relieve pain and decrease urgency to urinate	oxybutynin tolteridine	Ditropan Detrol
diuretic	to increase urination	bethanecol	Duvoid, Urecholine

Vocabulary Review

In the previous section, you learned terms relating to pharmacology. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. These etymologies (word histories) are for your information only. You do not need to memorize them.

Agent	Purpose
antispasmodic [ĂN-tē-spăz-MŎD-ĭk] anti-, against + spasmodic	Pharmacological agent that relieves spasms; also decreases frequency of urination.
diuretic [dī-yū-RĔT-ĭk] From Greek *dia-*, through + *ouresis*, urine	Pharmacological agent that increases urination.

CASE STUDY

Receiving Treatment

Ms. Jones recovered from her urinary tract infection but came in a few months later with swollen feet and high blood pressure. She was given a prescription, a list of dietary changes she should observe, and a course of mild, daily exercise to follow.

Critical Thinking

155. What type of medication do you think was prescribed for Ms. Jones?

156. How might diet help reduce swelling?

Pharmacological Terms Exercises

Know the Right Medication

Fill in the blanks.

157. To help relieve edema, a(n) _____ may be prescribed.

158. For dysuria, a(n) _____ may be prescribed.

159. For cystitis a(n) _____ may be prescribed.

160. Sudden contractions may lead to urinary incontinence and, therefore, a(n) _____ may be prescribed.

Challenge Section

Review the following doctor's notes and test results for a patient hospitalized with an unusually high fever, dysuria, and general malaise.

Critical Thinking

What do the abnormal results of the urinalysis indicate?
What other tests might be necessary to reach a diagnosis?

Meadow Health Systems, Inc.
1420 Glen Road
Meadowvale, OK 44444
111-222-3333

Run Date: 09/22/XX
Run Time: 1507

Page 1
Specimen Report

Patient: Dexter Judge	Acct #: E115592848	Loc:	U #:
Reg Dr: S. Anders, M.D.	Age/Sx: 40/M	Room:	Reg: 06/10/XX
	Status: Reg ER	Bed:	Des:

Spec #: 0922 : U00010R	Coll: 09/22/XX	Status: Comp	Req #: 00704169
	Recd.: 09/22/XX	Subm Dr:	
Entered: 06/10/XX–0936		Other Dr:	
Ordered: UA with micro			
Comments: Urine Description: Clean catch urine			

Test	Result	Flag	Reference
Urinalysis			
UA with micro			
COLOR	YELLOW		
APPEARANCE	CLEAR		
SP GRAVITY	1.017		1.001-1.030
GLUCOSE	4.7	**	NEG
BILIRUBIN	NEGATIVE		NEG
KETONE	NEGATIVE		NEG mg/dl
BLOOD	NEGATIVE		NEG
PH	5.0		4.5-8.0
PROTEIN	NEGATIVE		NEG mg/dl
UROBILINOGEN	NORMAL		NORMAL-1.0 mg/dl
NITRITES	NEGATIVE		NEG
LEUKOCYTES	NEGATIVE		NEG
WBC	8-10	**	0-5 /HPF
RBC	2-5		0-5 /HPF
EPI CELLS	0-2		/HPF
MUCUS	1+		

Patient 4

MEDICAL RECORD	PROGRESS NOTES
DATE 9/22/XX	Patient is a forty-year-old male admitted yesterday with symptoms including high fever and dysuria. Blood pressure normal; lungs clear. Urinalysis positive for glucose and white blood count. Test for infection. Talk to patient about high glucose reading.—Steve Anders, M.D.

PATIENT'S IDENTIFICATION *(For typed or written entries give: Name—last, first, middle; grade; rank; hospital or medical facility)*

Judge, Dexter
000-000-000

REGISTER NO. | WARD NO.

PROGRESS NOTES
STANDARD FORM 509

Terminology in Action

Below is a urinalysis for a 55-year old woman. Write a short paragraph explaining what pathology the abnormal readings might indicate.

Meadow Health Systems, Inc.
1420 Glen Road
Meadowvale, OK 44444
111-222-3333

Run Date: 09/22/XX
Run Time: 1507

Page 1
Specimen Report

Patient: Mary Langado
Reg Dr: S. Anders, M.D.

Acct #: E115592848
Age/Sx: 55/F
Status: Reg ER

Loc:
Room:
Bed:

U #:
Reg: 06/10/XX
Des:

Spec #: 0922 : U00010R
Coll: 09/22/XX
Recd.: 09/22/XX
Status: Comp
Subm Dr:
Req #: 00704181

Entered: 06/10/XX–0936
Ordered: UA with micro
Other Dr:
Comments: Urine Description: Clean catch urine

Test	Result	Flag	Reference
Urinalysis			
UA with micro			
COLOR	BROWNISH	***	
APPEARANCE	HAZY	***	
SP GRAVITY	1.017		1.001-1.030
GLUCOSE	5.2	**	NEG
BILIRUBIN	NEGATIVE		NEG
KETONE	NEGATIVE		NEG mg/dl
BLOOD	TRACE	***	NEG
PH	5.0		4.5-8.0
PROTEIN	NEGATIVE		NEG mg/dl
UROBILINOGEN	NORMAL		NORMAL-1.0 mg/dl
NITRITES	NEGATIVE		NEG
LEUKOCYTES	NEGATIVE		NEG
WBC	8-10	**	0-5 /HPF
RBC	2-5		0-5 /HPF
EPI CELLS	0-2		/HPF
MUCUS	1+		

Patient 5

Using the Internet

Go to the National Kidney Foundation's Web site (http://www.kidney.org) and enter the cyberNephrology site by typing *cybernephrology* in the search window. Write a short paragraph on what's new in transplantation or dialysis.

CHAPTER REVIEW

The material that follows is to help you review all the material in this chapter.

Using Your Allied Health Dictionary

Build a urinary term using each of the following word parts; define the word part and the term.

161. –ectomy: _____
162. –emia: _____
163. dips/o: _____
164. glycos/o: _____
165. –lithiasis: _____
166. –lith: _____
167. cyst/o: _____
168. nephr/o: _____
169. olig/o: _____
170. py/o: _____
171. ren/o: _____
172. –rrhaphy: _____
173. ur/o: _____
174. –plasty: _____
175. –scope: _____
176. –stenosis: _____
177. urethr/o: _____
178. ureter/o: _____
179. noct(o): _____
180. –megaly: _____
181. dys-: _____
182. anti-: _____
183. poly-: _____
184. retro-: _____
185. a-, an-: _____
186. –lysis: _____
187. urin/o: _____

Spelling Correctly

Circle the correct spelling.

188.	polydipsia	pollydipsia
189.	urethra	uretha
190.	urination	urinetion
191.	absces	abscess
192.	cathater	catheter
193.	bacteriuria	bacteruria
194.	nephrolithisis	nephrolithiasis

DEFINITIONS

Define the following terms and combining forms. Review the chapter before starting. Make sure you know how to pronounce each term as you define it. The blue words in brackets are references to the Spanish glossary available online at www.mhhe.com/medterm3e.

Word

195. acetone [ĂS-ĕ-tŌn] {acetona}
196. albumin [ăl-BYŪ-mĭn] {albúmina}
197. albuminuria [ăl-byū-mĭ-NŪ-rē-ă] {albuminuria}
198. antispasmodic [ĂN-tē-spăz-MŎD-ĭk]
199. anuria [ăn-YŪ-rē-ă] {anuria}
200. atresia [ă-TRĒ-zhē-ă] {atresia}
201. azotemia [ăz-ō-TĒ-mē-ă] {azoemia}
202. bilirubin [bĭl-ĭ-RŪ-bĭn] {bilirrubina}
203. bladder [BLĂD-ĕr] {vejiga}
204. bladder cancer
205. Bowman's capsule
206. Bright's disease
207. cali(o), calic(o)
208. calices, calyces (*sing.* calix, calyx) [KĂL-ĭ-sēz (KĀ-lĭks)] {calices}
209. casts
210. condom catheter [KŎN-dŏm KĂTH-ĕ-tĕr]
211. cortex [KŌR-tĕks] {corteza}
212. creatine [KRĒ-ă-tēn] {creatina}
213. creatinine [krē-ĂT-ĭ-nēn] {creatinina}
214. cyst(o)
215. cystectomy [sĭs-TĔK-tō-mē] {cistectomía}
216. cystitis [sĭs-TĪ-tĭs] {cistitis}
217. cystocele [SĬS-tō-sēl] {cistocele}
218. cystolith [SĬS-to-lĭth] {cistolito}
219. cystopexy [SĬS-tō-pĕk-sē]
220. cystoplasty [SĬS-tō-plăs-tē]
221. cystorrhaphy [sĭs-TŌR-ă-fē] {cistorrafia}
222. cystoscope [SĬS-tō-skōp] {cistoscopio}
223. cystoscopy [sĭs-TŎS-kō-pē]
224. dialysis [dī-ĂL-ĭ-sĭs] {dialysis}
225. diuretic [dī-yū-RĔT-ĭk]
226. dysuria [dĭs-YŪ-rē-ă] {disuria}
227. edema [ĕ-DĒ-mă] {edema}
228. end-stage renal disease (ESRD)
229. enuresis [ĕn-yū-RĒ-sĭs] {enuresis}
230. extracorporeal shock wave lithotripsy [ĔKS-tră-kōr-PŌR-ē-ăl shŏk wāv LĬTH-ō-trĭp-sē] (ESWL)
231. filtration [fĭl-TRĀ-shŭn] {filtración}
232. Foley [FŌ-lē] catheter
233. glomerul(o)
234. glomerulonephritis [glō-MĀR-yū-lō-nĕf-RĪ-tĭs]
235. glomerulus (*pl.*, glomeruli) [glō-MĀR-yū-lŏs (glō-MĀR-yū-lī)] {glomérulo}
236. glucose [GLŪ-kōs] {glucose}
237. hematuria [hē-mă-TŪ-rē-ă] {hematuria}
238. hemodialysis [HĒ-mō-dī-ĂL-ĭ-sĭs] {hemodiálisis}
239. hilum [HĪ-lŭm] {hilio}
240. hydronephrosis [HĪ-drō-nĕ-FRŌ-sĭs]
241. incontinence [ĭn-KŎN-tĭ-nĕns] {incontinecia}
242. indwelling [ĬN-dwĕ-lĭng]
243. intracorporeal electrohydraulic lithotripsy [ĬN-tră-kōr-PŌ-rē-ăl ē-LĔK-trō-hī-DRŌ-lĭk LĬTH-ō-trĭp-sē]
244. ketone [KĒ-tōn] {cetona}
245. ketonuria [kē-tō-NŪ-rē-ă] {cetonuria}
246. kidney [KĬD-ne] {riñón}
247. kidney failure
248. kidney, ureter, bladder (KUB)
249. lithotomy [lĭ-THŎT-ō-mē]
250. meat(o)
251. meatotomy [mē-ă-TŎT-ō-mē]
252. meatus [mē-Ă-tŭs] {meato}
253. medulla [mĕ-DŪL-ă] {médula}
254. nephrectomy [nĕ-FRĔK-tō-mē]
245. nephritis [nĕ-FRĪ-tĭs] {nefritis}
246. nephr(o)
247. nephroblastoma [NĔF-rō-blăs-TŌ-mă]
248. nephrolithotomy [NĔF-rō-lĭ-THŎT-ō-mē]
249. nephrolysis [nĕ-FRŎL-ĭ-sĭs] {nefrólisis}
250. nephroma [nĕ-FRŌ-mă] {nefroma}
251. nephron [NĔF-rŏn] {nefrona}
252. nephropexy [NĔF-rō-pĕk-sē]
253. nephrorrhaphy [nĕf-RŌR-ă-fē]
254. nephrosis [nĕ-FRŌ-sĭs] {nefrosis}
255. nephrostomy [nĕ-FRŎS-tō-mē]
256. nocturia [nŏk-TŪ-rē-ă] {nocturia}
257. oliguria [ŏl-ĭ-GŪ-rē-ă] {oliguria}
258. peritoneal [PĔR-ĭ-tō-NĒ-ăl] dialysis
259. pH {pH}
260. phenylketones [FĔN-ĭl-KĒ-tōns] (PKU)

Word

261. polycystic [pŏl-ē-SĬS-tĭk] kidney disease
262. polyuria [pŏl-ē-ŪR-ē-ă] {poliuria}
263. prostate [PRŎS-tāt] {próstata}
264. proteinuria [prō-tē-NŪ-rē-ă]
265. pyel(o)
266. pyelitis [pī-ĕ-LĪ-tĭs] {pielitis}
267. pyeloplasty [PĪ-ĕ-lō-PLĂS-tē]
268. pyelotomy [pi-ĕ-LŎT-ō-mē]
269. pyuria [pī-YŪ-rē-ă] {piuria}
270. reabsorption [rē-ăb-SŌRP-shŭn]
271. ren(o)
278. renal pelvis
279. renin [RĒ-nĭn] {renina}
280. renogram [RĒ-nō-grăm] {renograma}
281. resectoscope [rē-SĔK-tō-skōp] {resectoscopio}
282. retrograde pyelogram [RĔT-rō-grād PĪ-ĕl-ō-grăm] (RP)
283. retroperitoneal [RĔ-trō-PĔR-ĭ-tō-nē-ăl] {retroperitoneal}
284. specific gravity
285. trigon(o)
286. trigone [TRĪ-gōn] {trígono}
287. ur(o), urin (o)
288. urea [yū-RĒ-ă] {urea}
289. uremia [yū-RĒ-mē-ă] {uremia}
290. ureter(o)
291. ureter [yū-RĒ-tĕr] {uréter}
292. ureterectomy [yū-rē-tĕr-ĔK-tō-mē]
293. ureteroplasty [yū-RĒ-tĕr-ō-PLĂS-tē]
294. ureterorrhaphy [yū-rē-tĕr-ŌR-ă-fē]
295. urethr(o)
296. urethra [yū-RĒ-thră] {uretra}
297. urethropexy [yū-RĒ-thrō-pĕk-sē]
298. urethroplasty [yū-RĒ-thrō-PLĂS-tē]
299. urethrorrhaphy [yū-rē-THRŌR-ă-fē]
300. urethrostomy [yū-rē-THRŎS-tō-mē]
301. urethrotomy [yū-rē-THRŎT-ō-mē]
302. -uria
303. uric [YŪR-ĭk] acid
304. urinalysis [yū-rĭ-NĂL-ĭ-sĭs] {análisis de orina}
305. urinary [YŪR-ĭ-nār-ē] bladder
306. urinary system
307. urinary tract infection (UTI)
308. urine [YŪR-ĭn] {orina}
309. urology [yū-RŎL-ō-jē] {urología}
310. urostomy [yū-RŎS-tō-mē]
311. vesic(o)
312. voiding (urinating) cystourethrogram [sĭs-tō-yū-RĒ-thrō-grăm] (VCU, VCUG)
313. Wilms' [vĭlmz] tumor

Abbreviations

Write the full meaning of each abbreviation.

Abbreviation

314. ADH
315. A/G
316. AGN
317. ARF
318. BNO
319. BUN
320. CAPD
321. Cath
322. CRF
323. ESRD
324. ESWL
325. HD
326. IVP
327. K +
328. KUB
329. Na +
330. PH
331. PKU
332. RP
333. SG
334. UA
335. UTI
336. VCU, VCUG

Name _____ Date _____

Chapter 9: Word- Building (20 questions—1 pts. each)

Using the following combining forms, complete the word that best fits the definition of each word relating to the urinary system listed below. Combining forms may be used more than once.

cali(o)	nephr(o)	urin(o)
calic(o)	pyel(o)	ureter(o)
cyst(o)	reno	urethr(o)
glomerul(o)	trigon(o)	vesic(o)
meato	ur(o)	

1. Glomerular disease: _____ pathy
2. Inflammation of the urinary bladder: _____ itis
3. Kidney enlargement: _____ megaly
4. Removal of a bladder stone: _____ lithotomy
5. Instrument for inspecting the urethral passageway: _____ scope
6. Excessive urea in the blood: _____ emia
7. Repair of a calyx: _____ plasty
8. Narrowing of the urethra: _____ stenosis
9. Kidney tumor: _____ oma
10. Hernia of the urinary bladder: _____ cele
11. Study and treatment of the urinary system: _____ logy
12. Repair of the meatus: _____ plasty
13. Bladder suture: _____ rrhaphy
14. Incision into the calyx: _____ otomy
15. Of the kidneys and stomach: _____ gastric
16. Fluoroscopic examination of the renal pelvis: _____ fluoroscopy
17. Inflammation of the bladder and urether: _____ urethritis
18. Kidney condition: _____ osis
19. Suture of the meatus: _____ rrhaphy
20. Inflammation of the glomeruli of the kidney: _____ nephritis