Case Study
E.O.'s Stress Incontinence

Chief complaint:
E.O. is a 52-year-old Asian female with a history of stress incontinence. The condition has affected her quality of life, as she is not able to be active in athletics without worrying about urinary leakage under physical strain. E.O. has cut back on her sports participation and currently is involved in only two golf leagues. Although the incontinence continues to be a problem, she does not want to take medication or have corrective surgery. E.O. heard about a minimally invasive research protocol that could potentially address the incontinence. She decided to investigate to see if she would be a candidate for the study.

Examination:
E.O. met with the research nurse who explained the study to her. She was told the study hoped to achieve around 75 percent improvement, which E.O. found acceptable. A urologic history was taken involving questions relating to urinary frequency, urgency, and nocturia. A few procedures were required at the beginning of the study that would determine eligibility. E.O. was required to provide a clean catch specimen and underwent a cystometrography (CMG) and a cystoscopy. The results indicated that she would be a good candidate for the research trial. She was required to maintain a urinary diary for two weeks and record when the stress incontinence and urgency occurred. E.O. proceeded with the study.

Clinical course:
The clinical study involved taking muscle cells from E.O.'s thigh, growing them in a laboratory, and then reinserting cultured stem cells (myoblasts) into the area surrounding the urethra. Theoretically, these actively growing cells would promote sphincter muscle development and provide greater control of urination. The urologist took a punch biopsy from E.O.'s thigh muscle to obtain the necessary cells. After laboratory processing, the active cells were injected into place. They were allowed to settle and grow for three months, at which time another CMG and cystoscopy were performed. A comparison was made with the original test results to see if there was any improvement in the stress incontinence. All procedures were conducted in the office with minimal discomfort.
Ancillaries At-A-Glance

Visit thePoint to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS
- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES
- E-book: Chapter 13
- Web Figure: Urinary Obstruction, Reflux, and Infection
- Web Figure: Acute Pyelonephritis
- Web Figure: Hydronephrosis
- Web Chart: Role of Hormones in Electrolyte Balance
- Animation: Renal Function
- Audio Pronunciation Glossary

Learning ACTIVITIES
- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After the study of this chapter, you should be able to:

1. Describe the functions of the urinary system. p.318
2. Name and describe the organs of the urinary tract and cite the functions of each. p.318
3. Identify the portions of the nephron. p.320
4. Explain the relationship between the kidney and the blood circulation. p.320
5. Describe the processes involved in urine formation. p.320
6. Explain how urine is transported and released from the body. p.321
7. Identify and use the roots pertaining to the urinary system. p.323
8. Describe six major disorders of the urinary system. p.325
9. Interpret abbreviations used in reference to the urinary system. p.335
10. Analyze medical terms in case studies pertaining to the urinary system. pp.316, 343
Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

1. The organ that forms urine is the:
   a. gallbladder
   b. cystic duct
   c. bladder
   d. kidney

2. The tube that carries urine out of the body is the:
   a. pylorus
   b. appendix
   c. urethra
   d. peristalsis

3. The hormone erythropoietin stimulates production of:
   a. red blood cells
   b. platelets
   c. leukocytes
   d. saliva

4. Micturition is the scientific term for:
   a. urination
   b. digestion
   c. breathing
   d. retention

5. With reference to the urinary system, the root *cyst/o* means:
   a. ureter
   b. urinary bladder
   c. urinary stasis
   d. kidney

6. Nephritis is inflammation of the:
   a. liver
   b. intestine
   c. bladder
   d. kidney

7. Separation of substances by passage through a membrane is termed:
   a. centrifugation
   b. absorption
   c. deglutition
   d. dialysis

8. A substance that promotes urinary output is a(n):
   a. hypertensive
   b. diuretic
   c. channel blocker
   d. enzyme

The urinary system excretes metabolic waste. In forming and eliminating urine, it also regulates the composition, volume, and acid-base balance (pH) of body fluids. In several ways, kidney activity affects the circulation. The urinary system is thus of critical importance in maintaining homeostasis, the state of internal balance. As shown in Figure 13-1, the urinary system consists of:
- Two kidneys, the organs that form urine
- Two ureters, which transport urine from the kidneys to the bladder
- The urinary bladder, which stores and eliminates urine
- The urethra, which carries urine out of the body

In addition, the kidneys produce two substances that act on the circulatory system:
- **Erythropoietin** (EPO), a hormone that stimulates red blood cell production in the bone marrow.
- **Renin**, an enzyme that functions to raise blood pressure. It activates a blood component called angiotensin, which causes constriction of the blood vessels. The drugs known as ACE inhibitors (angiotensin-converting enzyme inhibitors) lower blood pressure by interfering with the production of angiotensin.

**LOCATION AND STRUCTURE OF THE KIDNEYS**

The kidneys are located behind the peritoneum in the lumbar region. On the top of each kidney rests an adrenal gland. The kidney is encased in a capsule of fibrous connective tissue overlaid with fat. An outermost layer of connective tissue supports the kidney and anchors it to the body wall.

If you look inside the kidney (Fig. 13-2), you will see that it has an outer region, the renal cortex, and an inner region, the renal medulla (see Box 13-1). The medulla is divided into
**Figure 13-1** The male urinary system. The urinary system is shown along with nearby blood vessels and the adrenal glands.

**Figure 13-2** The kidney. (Left) A longitudinal section through the kidney shows its internal structure. The hilum is the point where blood vessels and ducts connect with the kidney. (Right) An enlarged diagram of nephrons. Each kidney contains more than 1 million nephrons.
Words That Serve Double Duty

Some words appear in more than one body system to represent different structures. The medulla of the kidney is the inner portion of the organ. Other organs, such as the adrenal gland, ovary, and lymph nodes, may also be divided into a central medulla and outer cortex. But medulla means “marrow,” and this term also applies to the bone marrow, to the spinal cord, and to the part of the brain that connects with the spinal cord, the medulla oblongata.

A ventricle is a chamber. There are ventricles in the brain and in the heart. The word fundus means the back part or base of an organ. The uterus has a fundus, the upper rounded portion farthest from the cervix, as does the stomach. The fundus of the eye, examined for signs of diabetes and glaucoma, is the innermost layer, where the retina is located. A macula is a spot. There is a macula in the eye, which is the point of sharpest vision. There is also a macula in the ear, which contains receptors for equilibrium.

In interpreting medical terminology, it is often important to know the context in which a word is used.

triangular sections, the renal pyramids. These pyramids have a lined appearance because they are made up of the loops and collecting tubules of the nephrons, the kidney’s functional units. Each collecting tubule empties into a urine-collecting area called a calyx (from the Latin word meaning “cup”). Several of the smaller minor calices merge to form a major calyx. The major calices then unite to form the renal pelvis, the upper funnel-shaped portion of the ureter.

THE NEPHRONS

The tiny working units of the kidneys are the nephrons (Fig. 13-3). Each of these microscopic structures is basically a single tubule coiled and folded into various shapes. The tubule begins with a cup-shaped glomerular (Bowman) capsule, which is part of the nephron’s blood-filtering device. The tubule then folds into the proximal tubule, straightens out to form the nephron loop (loop of Henle), coils again into the distal tubule, and then finally straightens out to form a collecting duct.

BLOOD SUPPLY TO THE KIDNEY

Blood enters the kidney through a renal artery, a short branch of the abdominal aorta. This vessel subdivides into smaller vessels as it branches throughout the kidney tissue, until finally blood is brought into the glomerular capsule and circulated through a cluster of capillaries, called a glomerulus, within the capsule.

Blood leaves the kidney by a series of vessels that finally merge to form the renal vein, which empties into the inferior vena cava.

Urine Formation

As blood flows through the glomerulus, blood pressure forces materials through the glomerular wall and through the wall of the glomerular capsule into the nephron. The fluid that enters the nephron, the glomerular filtrate, consists mainly of water, electrolytes, soluble wastes, nutrients, and toxins. The main waste material is urea, the nitrogenous (nitrogen-containing) byproduct of protein metabolism. The filtrate should not contain any cells or proteins, such as albumin.
The waste material and the toxins must be eliminated, but most of the water, electrolytes, and nutrients must be returned to the blood, or we would rapidly starve and dehydrate. This return process, termed tubular reabsorption, occurs through the peritubular capillaries that surround the nephron.

As the filtrate flows through the nephron, other processes further regulate its composition and pH. The filtrate's concentration is also adjusted under the effects of a pituitary hormone. **Antidiuretic hormone (ADH)** promotes reabsorption of water, thus concentrating the filtrate. The final filtrate, now called urine, flows into the collecting ducts to be eliminated. A **diuretic** is a substance that promotes increased urinary output or diuresis. Diuretic drugs are used in treating hypertension and heart failure to decrease fluid volume and reduce the heart's workload (see Chapter 9).

**TRANSPORT AND REMOVAL OF URINE**

Urine is drained from the renal pelvis and carried by the left and right ureters to the urinary bladder (Fig. 13-4), where it is stored. As the bladder fills, it expands upward from a stable triangle at its base. This triangle, the **trigone**, is marked by the ureteral openings and the urethral opening below (see Fig. 13-4). The trigone's stability prevents urine from refluxing into the ureters.

Fullness stimulates a reflex contraction of the bladder muscle and expulsion of urine through the **urethra**. The female urethra is short (4 cm [1.5 in.]) and carries only urine. The male urethra is longer (20 cm [8 in.]) and carries both urine and semen.

The **voiding** (release) of urine, technically called **micturition** or **urination**, is regulated by two sphincters (circular muscles) that surround the urethra. The superior muscle, the internal urethral sphincter, is around the entrance to the urethra and functions involuntarily; the inferior muscle, the external urethral sphincter, is under conscious control. An inability to retain urine is termed **urinary incontinence**.

**Terminology**

**Key Terms**

**Normal Structure and Function**

<table>
<thead>
<tr>
<th><strong>Term</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>antidiuretic hormone (ADH)</td>
<td>A hormone released from the pituitary gland that causes water reabsorption in the kidneys, thus concentrating the urine</td>
</tr>
<tr>
<td>angiotensin</td>
<td>A substance that increases blood pressure; activated in the blood by renin, an enzyme produced by the kidneys</td>
</tr>
<tr>
<td>calyx</td>
<td>A cup-like cavity in the pelvis of the kidney; also calix (plural: calices) (roots: cali, calc)</td>
</tr>
<tr>
<td>diuresis</td>
<td>Excretion of urine; usually meaning increased urinary excretion</td>
</tr>
<tr>
<td>diuretic</td>
<td>A substance that increases the excretion of urine; pertaining to diuresis</td>
</tr>
<tr>
<td>erythropoietin (EPO)</td>
<td>A hormone produced by the kidneys that stimulates red blood cell production in the bone marrow</td>
</tr>
</tbody>
</table>

(Continued)
### Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>glomerular capsule</td>
<td>The cup-shaped structure at the beginning of the nephron that surrounds the glomerulus and receives material filtered out of the blood; Bowman (BO-man) capsule</td>
</tr>
<tr>
<td>glomerular filtrate</td>
<td>The fluid and dissolved materials that filter out of the blood and enter the nephron through the glomerular capsule</td>
</tr>
<tr>
<td>glomerulus</td>
<td>The cluster of capillaries within the glomerular capsule (plural: glomeruli) (root: glomeruli)</td>
</tr>
<tr>
<td>kidney</td>
<td>An organ of excretion (roots: ren/o, neph/o); the two kidneys filter the blood and form urine, which contains metabolic waste products and other substances as needed to regulate the water, electrolyte, and pH balance of body fluids</td>
</tr>
<tr>
<td>micturation</td>
<td>The voiding of urine; urination</td>
</tr>
<tr>
<td>nephron</td>
<td>A microscopic functional unit of the kidney; working with blood vessels, the nephron filters the blood and balances the composition of urine</td>
</tr>
<tr>
<td>renal cortex</td>
<td>The kidney’s outer portion; contains portions of the nephrons</td>
</tr>
<tr>
<td>renal medulla</td>
<td>The kidney’s inner portion; contains portions of the nephrons and ducts that transport urine toward the renal pelvis</td>
</tr>
<tr>
<td>renal pelvis</td>
<td>The expanded upper end of the ureter that receives urine from the kidney; Greek root <em>pyello</em> means “basin”</td>
</tr>
<tr>
<td>renal pyramid</td>
<td>A triangular structure in the renal medulla; composed of the nephrons’ loops and collecting ducts</td>
</tr>
<tr>
<td>renin</td>
<td>An enzyme produced by the kidneys that activates angiotensin in the blood</td>
</tr>
<tr>
<td>trigone</td>
<td>A triangle at the base of the bladder formed by the openings of the two ureters and the urethra (see Fig. 13-4)</td>
</tr>
<tr>
<td>tubular reabsorption</td>
<td>The return of substances from the glomerular filtrate to the blood through the peritubular capillaries</td>
</tr>
<tr>
<td>urea</td>
<td>The main nitrogenous (nitrogen-containing) waste product in the urine</td>
</tr>
<tr>
<td>ureter</td>
<td>The tube that carries urine from the kidney to the bladder (root: ureter/o)</td>
</tr>
<tr>
<td>urethra</td>
<td>The tube that carries urine from the bladder to the outside of the body (roots: ureth/o)</td>
</tr>
<tr>
<td>urinary bladder</td>
<td>The organ that stores and eliminates urine excreted by the kidneys (roots: cyst/o, vesic/o)</td>
</tr>
<tr>
<td>urination</td>
<td>The voiding of urine; micturition</td>
</tr>
<tr>
<td>urine</td>
<td>The fluid excreted by the kidneys. It consists of water, electrolytes, urea, other metabolic wastes, and pigments. A variety of other substances may appear in urine in cases of disease (root: ur/o)</td>
</tr>
</tbody>
</table>

**PASSport to Success**

Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.
Roots Pertaining to the Urinary System

See Tables 13-1 and 13-2.

Table 13-1 Roots for the Kidney

<table>
<thead>
<tr>
<th>Root</th>
<th>Meaning</th>
<th>Example</th>
<th>Definition of Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>ren/o</td>
<td>kidney</td>
<td>suprarenal</td>
<td>above the kidney</td>
</tr>
<tr>
<td>nephru/o</td>
<td>kidney</td>
<td>nephrosis</td>
<td>any noninflammatory disease condition of the kidney</td>
</tr>
<tr>
<td>glomerul/o</td>
<td>glomerulus</td>
<td>juxtaglomerular</td>
<td>near the glomerulus</td>
</tr>
<tr>
<td>pyel/o</td>
<td>renal pelvis</td>
<td>pyelectasis</td>
<td>dilatation of the renal pelvis</td>
</tr>
<tr>
<td>cali/o, calic/o</td>
<td>calyx</td>
<td>calicetal</td>
<td>pertaining to a renal calyx (note addition of e); also spelled calyceal</td>
</tr>
</tbody>
</table>

EXERCISE 13-1

Use the root ren/o to write a word for the following:

1. behind (post-) the kidney  
   postrenal
2. before or in front of (pre-) the kidney
3. between the kidneys
4. around the kidneys

Use the root nephru/o to write a word for the following:

5. study of the kidney
6. any disease of the kidney
7. poisonous or toxic to the kidney
8. softening of the kidney
9. surgical removal of the kidney

Use the appropriate root to write a word for the following:

10. inflammation of a glomerulus
11. dilatation of a renal calyx
12. plastic repair of the renal pelvis
13. radiograph of the renal pelvis
14. radiographic study (-graphy) of the kidney
15. incision of a renal calyx
16. hardening of a glomerulus
17. inflammation of the renal pelvis and kidney
Table 13-2 Roots for the Urinary Tract (Except the Kidney)

<table>
<thead>
<tr>
<th>Root</th>
<th>Meaning</th>
<th>Example</th>
<th>Definition of Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>ur/o</td>
<td>urine, urinary tract</td>
<td>urosepsis</td>
<td>generalized infection that originates in the urinary tract</td>
</tr>
<tr>
<td>urin/o</td>
<td>urine</td>
<td>nocturia</td>
<td>urination during the night (nɔtɪˈriʊə)</td>
</tr>
<tr>
<td>ureter/o</td>
<td>ureter</td>
<td>ureterostenosis</td>
<td>narrowing of the ureter</td>
</tr>
<tr>
<td>cyst/o</td>
<td>urinary bladder</td>
<td>cystocele</td>
<td>hernia of the urinary bladder</td>
</tr>
<tr>
<td>vesic/o</td>
<td>urinary bladder</td>
<td>intravesical</td>
<td>within the urinary bladder</td>
</tr>
<tr>
<td>urethr/o</td>
<td>urethra</td>
<td>urethroctome</td>
<td>instrument for incising the urethra</td>
</tr>
</tbody>
</table>

EXERCISE 13-2

Use the root ur/o to write a word for the following:

1. study of the urinary tract
2. radiography of the urinary tract
3. a urinary calculus (stone)
4. presence of urinary waste products in the blood

The root ur/o is used in the suffix -uria, which means “condition of urine or of urination.” Use -uria to write a word for the following:

5. lack of urine
6. painful or difficult urination
7. formation of excess (poly-) urine
8. presence of cells in the urine
9. presence of blood (hemat/o) in the urine

The suffix -uresis means “urination.” Use -uresis to write a word for the following:

10. increased excretion of urine
11. lack of urination
12. excretion of sodium (natri-) in the urine
13. excretion of potassium (kali-) in the urine

The adjective ending for the above words is -uretic, as in diuretic (pertaining to diuresis) and natriuretic (pertaining to the excretion of sodium in the urine).

Use the appropriate root to write a word for the following:

14. surgical fixation of the urethra
15. surgical creation of an opening in the urether
Clinical Aspects of the Urinary System

INFECTIONS

Organisms that infect the urinary tract generally enter through the urethra and ascend toward the bladder, producing cystitis. Untreated, the infection can ascend even further into the urinary tract. The infecting organisms are usually colon bacteria carried in feces, particularly *Escherichia coli*. Although urinary tract infections (UTIs) do occur in men, they appear more commonly in women because the female urethra is shorter than the male urethra and its opening is closer to the anus. Poor toilet habits and urinary stasis are contributing factors. In hospitals, UTIs may result from procedures involving the urinary system, especially catheterization, in which a tube is inserted into the bladder to withdraw urine (Fig. 13-5). Less frequently, UTIs originate in the blood and descend through the urinary system.

An infection that involves the kidney and renal pelvis is termed pyelonephritis. As in cystitis, signs of this condition include dysuria, painful or difficult urination, and the presence of bacteria and pus in the urine, bacteriuria and pyuria, respectively.

Urethritis is inflammation of the urethra, generally associated with sexually transmitted infections such as gonorrhea and chlamydial infections (see Chapter 14).

GLOMERULONEPHRITIS

Although the name simply means inflammation of the glomeruli and kidney, glomerulonephritis is a specific disorder that follows an immunologic reaction. It is usually a response to infection in another system, commonly a streptococcal infection of the respiratory tract or a skin infection. It may also accompany autoimmune diseases such as lupus erythematosus. The symptoms are hypertension, edema, and oliguria, the passage of small amounts of urine. This urine is highly concentrated. Because of damage to kidney tissue, blood and proteins escape into the nephrons, causing hematuria, blood in the urine, and proteinuria, protein in the urine. Blood cells may also form into small molds of the kidney tubule, called casts, which can be found in the urine. Most patients fully recover from glomerulonephritis, but in some cases, especially among the elderly, the disorder may lead to chronic renal failure (CRF) or end-stage renal disease (ESRD). In such cases, urea and other nitrogenous compounds accumulate in the blood, a condition termed uremia. These compounds affect the central nervous system, causing irritability, loss of appetite, stupor, and other symptoms. There is also electrolyte imbalance and acidosis.
kidney function with oliguria and accumulation of nitrogenous wastes in the blood. Failure of the kidneys to eliminate potassium leads to hyperkalemia, along with other electrolyte imbalances and acidosis (see Box 13-2). When destruction (necrosis) of kidney tubules is involved, the condition may be referred to as acute tubular necrosis (ATN).

Renal failure may lead to a need for kidney dialysis or, ultimately, renal transplantation. Dialysis refers to the movement of substances across a semipermeable membrane; it is a method used to eliminate harmful or unnecessary substances from the body when the kidneys are impaired or have been removed (Fig. 13-6). Two approaches are used:

- In hemodialysis, blood is cleansed by passage over a membrane surrounded by fluid (dialysate) that draws out unwanted substances. Most people on hemodialysis are treated for four hours three times a week in a dialysis center. Some patients are able to use simpler machines at home for daily dialysis. Box 13-3 has information on careers in hemodialysis treatment.
- In peritoneal dialysis, fluid is introduced into the peritoneal cavity. The fluid, along with waste products, is periodically withdrawn and replaced (Fig. 13-7). Fluid may be exchanged at intervals throughout the day in continuous ambulatory peritoneal dialysis (CAPD) or during the night in continuous cyclic peritoneal dialysis (CCPD).

**URINARY STONES**

Urinary lithiasis (presence of stones) may be related to infection, irritation, diet, or hormone imbalances that lead to increased calcium in the blood. Most urinary calculi (stones) are made up of calcium salts, but they may be composed of

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**Box 13-2**

**Clinical Perspectives**

**Sodium and Potassium: Causes and Consequences of Imbalance**

Sodium and potassium concentrations in body fluids are important measures of water and electrolyte balance. An excess of sodium in body fluids is termed hypernatremia, taken from the Latin name for sodium, natrium. This condition accompanies dehydration and severe vomiting and may cause hypertension, edema, convulsions, and coma. Hyponatremia, a sodium deficiency in body fluids, can come from water intoxication (overhydration), heart failure, kidney failure, cirrhosis of the liver, pH imbalance, or endocrine disorders. It can cause muscle weakness, hypotension, confusion, shock, convulsions, and coma.

The term hyperkalemia is taken from the Latin name for potassium, kalium. It refers to excess potassium in body fluids, which may result from kidney failure, dehydration, and other causes. Its signs and symptoms include nausea, vomiting, muscular weakness, and severe cardiac arrhythmias. Hypokalemia, or low potassium in body fluids, may result from taking diuretics that cause potassium to be lost along with water. It may also result from pH imbalance or secretion of too much aldosterone from the adrenal cortex, resulting in potassium excretion. Hypokalemia causes muscle fatigue, paralysis, confusion, hypoventilation, and cardiac arrhythmias.
Hemodialysis Technician

A hemodialysis technician, also called a renal technician or a nephrology technician, specializes in the safe and effective delivery of renal dialysis therapy to patients suffering from kidney failure. Before treatment begins, the technician prepares the dialysis solutions and ensures that the dialysis machine is clean, sterile, and in proper working order. The technician measures and records the patient’s weight, temperature, and vital signs, inserts a catheter into the patient’s arm, and connects the dialysis machine to it. During dialysis, the technician monitors the patient for adverse reactions and guards against any equipment malfunction. After the treatment is completed, the technician again measures and records the patient’s weight, temperature, and vital signs. To perform these duties, hemodialysis technicians need thorough scientific and clinical training. Most technicians in the United States receive their training from a college or technical school, and many states require that the technician be certified.

Hemodialysis technicians work in a variety of settings, such as hospitals, clinics, and patients’ homes. As populations age, the incidence of kidney disease is expected to rise, as will the need for hemodialysis. For more information about this career, contact the National Association of Nephrology Technicians at www.dialysisnet.org.
Peritoneal dialysis. The peritoneum, a semipermeable membrane richly supplied with small blood vessels, lines the peritoneal cavity. Waste products diffuse from the network of blood vessels into the dialysate in the peritoneal cavity.

Figure 13-7 Peritoneal dialysis. The peritoneum, a semipermeable membrane richly supplied with small blood vessels, lines the peritoneal cavity. Waste products diffuse from the network of blood vessels into the dialysate in the peritoneal cavity.

Figure 13-8 Calculus formation in the urinary tract. Various possible sites of calculus (stone) formation are shown.

Figure 13-9 Lithotripsy. Shock waves are used to break kidney stones and allow for their passage. The procedure is called extracorporeal shock-wave lithotripsy (ESWL).

Figure 13-10 Cystoscopy. A lighted cystoscope is introduced through the urethra into the bladder of a male subject. Sterile fluid is used to inflate the bladder. Cystoscopes are used to examine the bladder, take biopsy specimens, and remove tumors.

Because they are radiopaque, stones can usually be seen on simple radiographs of the abdomen. Stones may dissolve and pass out of the body on their own. If not, they may be removed surgically, in a lithotomy, or by endoscopy. External shock waves are used to crush stones in the urinary tract in a procedure called extracorporeal (outside the body) shock-wave lithotripsy (crushing of stones) (Fig. 13-9).

CANCER
Carcinoma of the bladder has been linked to occupational exposure to chemicals, parasitic infections, and cigarette smoking. A key symptom is sudden, painless hematuria. Often, the cancer can be seen by viewing the bladder lining with a cystoscope (Fig. 13-10). This instrument can also be used to biopsy tissue for study.
ileum in an ileal conduit (Fig. 13-11), or to some other portion of the intestine.

Cancer may also involve the kidney and renal pelvis. Additional means for diagnosing cancer and other urinary tract disorders include ultrasound, computed tomography scans, and radiographic studies such as intravenous urography (IVU) (Fig. 13-12), also called intravenous pyelography (IVP), and retrograde pyelography.

**URINALYSIS**

Urinalysis (UA) is a simple and widely used method for diagnosing urinary tract disorders. It may also reveal disturbances in other systems when abnormal byproducts are eliminated in the urine. In a routine UA, the urine is grossly examined for color and turbidity (a sign that bacteria are present); specific gravity (SG) (a measure of concentration) and pH are recorded; tests are performed for chemical components such as glucose, ketones, and hemoglobin; and the urine is examined microscopically for cells, crystals, and casts. In more detailed tests, drugs, enzymes, hormones, and other metabolites may be analyzed, and bacterial cultures may be performed.

**Figure 13-11** Ileal conduit. In this surgery, the ureters are vented to the body surface through the ileum when the bladder is removed or nonfunctional.

**Figure 13-12** Intravenous urogram. The image shows the renal pelves, ureters, and urinary bladder.
**Terminology**

<table>
<thead>
<tr>
<th>Key Terms</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disorders</strong></td>
<td></td>
</tr>
<tr>
<td>acidosis</td>
<td>Excessive acidity of body fluids</td>
</tr>
<tr>
<td>bacteriuria</td>
<td>Presence of bacteria in the urine</td>
</tr>
<tr>
<td>cast</td>
<td>A solid mold of a renal tubule found in the urine</td>
</tr>
<tr>
<td>cystitis</td>
<td>Inflammation of the urinary bladder, usually as a result of infection</td>
</tr>
<tr>
<td>dysuria</td>
<td>Painful or difficult urination</td>
</tr>
<tr>
<td>glomerulonephritis</td>
<td>Inflammation of the kidney primarily involving the glomeruli. The acute form usually occurs after an infection elsewhere in the body; the chronic form varies in cause and usually leads to renal failure</td>
</tr>
<tr>
<td>hematuria</td>
<td>Presence of blood in the urine</td>
</tr>
<tr>
<td>hydronephrosis</td>
<td>Collection of urine in the renal pelvis caused by obstruction; results in distention and renal atrophy</td>
</tr>
<tr>
<td>hypokalemia</td>
<td>Deficiency of potassium in the blood</td>
</tr>
<tr>
<td>hyponatremia</td>
<td>Deficiency of sodium in the blood</td>
</tr>
<tr>
<td>hypoproteinemia</td>
<td>Decreased amount of protein in the blood; may be caused by kidney damage resulting in protein loss</td>
</tr>
<tr>
<td>hyperkalemia</td>
<td>Excess amount of potassium in the blood</td>
</tr>
<tr>
<td>hypernatremia</td>
<td>Excess amount of sodium in the blood</td>
</tr>
<tr>
<td>nephrotic syndrome</td>
<td>Condition that results from glomerular damage leading to loss of protein in the urine (proteinuria). There is low plasma protein (hypoproteinemia), edema, and increased blood lipids as the liver releases lipoproteins. Also called nephrosis</td>
</tr>
<tr>
<td>oliguria</td>
<td>Elimination of small amounts of urine</td>
</tr>
<tr>
<td>proteinuria</td>
<td>Presence of protein, mainly albumin, in the urine</td>
</tr>
<tr>
<td>pyelonephritis</td>
<td>Inflammation of the renal pelvis and kidney, usually caused by infection</td>
</tr>
<tr>
<td>pyuria</td>
<td>Presence of pus in the urine</td>
</tr>
<tr>
<td>renal colic</td>
<td>Radiating pain in the region of the kidney associated with the passage of a stone</td>
</tr>
<tr>
<td>uremia</td>
<td>Presence of toxic levels of urea and other nitrogenous substances in the blood as a result of renal insufficiency</td>
</tr>
<tr>
<td>urethritis</td>
<td>Inflammation of the urethra, usually due to infection</td>
</tr>
<tr>
<td>urinary stasis</td>
<td>Stoppage of urine flow; urinary stagnation</td>
</tr>
</tbody>
</table>
### Terminology

#### Key Terms (Continued)

**Diagnosis and Treatment**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>catheterization</td>
<td>Introduction of a tube into a passage, such as through the urethra into the bladder for withdrawal of urine. (see Fig. 13-5)</td>
</tr>
<tr>
<td>cystoscope</td>
<td>An instrument for examining the interior of the urinary bladder. Also used for removing foreign objects, for surgery, and for other forms of treatment.</td>
</tr>
<tr>
<td>dialysis</td>
<td>Separation of substances by passage through a semipermeable membrane. Dialysis is used to rid the body of unwanted substances when the kidneys are impaired or missing. The two forms of dialysis are hemodialysis and peritoneal dialysis.</td>
</tr>
<tr>
<td>hemodialysis</td>
<td>Removal of unwanted substances from the blood by passage through a semipermeable membrane. (see Fig. 13-6)</td>
</tr>
<tr>
<td>intravenous pyelography (IVP)</td>
<td>Intravenous urography. (see Fig. 13-12)</td>
</tr>
<tr>
<td>intravenous urography (IVU)</td>
<td>Radiographic visualization of the urinary tract after intravenous administration of a contrast medium that is excreted in the urine; also called excretory urography or intravenous pyelography, although the latter is less accurate because the procedure shows more than just the renal pelvis.</td>
</tr>
<tr>
<td>lithotripsy</td>
<td>Crushing of a stone. (see Fig. 13-9)</td>
</tr>
<tr>
<td>peritoneal dialysis</td>
<td>Removal of unwanted substances from the body by introduction of a dialyzing fluid into the peritoneal cavity followed by removal of the fluid. (see Fig. 13-7)</td>
</tr>
<tr>
<td>retrograde pyelography</td>
<td>Pyelography in which the contrast medium is injected into the kidneys from below, by way of the ureters.</td>
</tr>
<tr>
<td>specific gravity (SG)</td>
<td>The weight of a substance compared with the weight of an equal volume of water. The specific gravity of normal urine ranges from 1.015 to 1.025. This value may increase or decrease in disease.</td>
</tr>
<tr>
<td>urinalysis (UA)</td>
<td>Laboratory study of the urine. Physical and chemical properties and microscopic appearance are included.</td>
</tr>
</tbody>
</table>

**Surgery**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cystectomy</td>
<td>Surgical removal of all or part of the urinary bladder.</td>
</tr>
<tr>
<td>ileal conduit</td>
<td>Diversion of urine by connection of the ureters to an isolated segment of the ileum. One end of the segment is sealed, and the other drains through an opening in the abdominal wall. (see Fig. 13-11). A procedure used when the bladder is removed or nonfunctional. Also called ileal bladder.</td>
</tr>
<tr>
<td>lithotomy</td>
<td>Incision of an organ to remove a stone (calculus)</td>
</tr>
<tr>
<td>renal transplantation</td>
<td>Surgical implantation of a donor kidney into a patient</td>
</tr>
</tbody>
</table>
### Terminology Supplementary Terms

#### Normal Structure and Function

- **aldosterone**  
  ald-OSS-ter-on  
  A hormone secreted by the adrenal gland that regulates electrolyte excretion by the kidneys

- **clearance**  
  The volume of plasma that the kidneys can clear of a substance per unit of time; renal plasma clearance

- **creatinine**  
  kre-AT-in-in  
  A nitrogenous byproduct of muscle metabolism. An increase in blood creatinine is a sign of renal failure

- **detrusor muscle**  
  de-TRUS-or  
  The muscle in the bladder wall

- **glomerular filtration rate (GFR)**  
  The amount of filtrate formed per minute by both kidneys

- **maximal transport capacity (Tm)**  
  The maximum rate at which a given substance can be transported across the renal tubule; tubular maximum

- **renal corpuscle**  
  KOR-pus-kl  
  The glomerular capsule and the glomerulus considered as a unit; the filtration device of the kidney

#### Symptoms and Conditions

- **anuresis**  
  an-UR-eh-sis  
  Lack of urination

- **anuria**  
  an-UH-ri-a  
  Lack of urine formation

- **azotemia**  
  az-OH-te-mee-a  
  Presence of increased nitrogenous waste, especially urea, in the blood

- **azoturia**  
  az-OH-tu-ri-a  
  Presence of increased nitrogenous compounds, especially urea, in the urine

- **cystocele**  
  SIS-to-sehl  
  Herniation of the bladder into the vagina (see Fig. 15-12); vesicocele

- **dehydration**  
  de-hy-DRAY-shun  
  Excessive loss of body fluids

- **diabetes insipidus**  
  di-AH-be-tiss IN-sip-id-us  
  A condition caused by inadequate production of antidiuretic hormone, resulting in excessive excretion of dilute urine and extreme thirst

- **enuresis**  
  en-UR-eh-sis  
  Involuntary urination, usually at night; bed-wetting

- **epispadias**  
  ep-I-SPA-de-as  
  A congenital condition in which the urethra opens on the dorsal surface of the penis as a groove or cleft; anasplasia

- **glycosuria**  
  gly-KOH-soo-ri-a  
  Presence of glucose in the urine, as in cases of diabetes mellitus

- **horseshoe kidney**  
  A congenital union of the lower poles of the kidneys, resulting in a horseshoe-shaped organ (Fig. 13-13)

- **hydroureter**  
  hy-DOO-air-er  
  Distention of the ureter with urine due to obstruction

- **hypospadias**  
  hi-poh-SPA-de-as  
  A congenital condition in which the urethra opens on the undersurface of the penis or into the vagina (Fig. 13-14)
### Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>hypovolemia</td>
<td>A decrease in blood volume</td>
</tr>
<tr>
<td>neurogenic bladder</td>
<td>Any bladder dysfunction that results from a central nervous system lesion</td>
</tr>
<tr>
<td>nocturia</td>
<td>Excessive urination at night (noci/o means “night”)</td>
</tr>
<tr>
<td>polycystic kidney disease</td>
<td>A hereditary condition in which the kidneys are enlarged and contain many cysts (Fig. 13-15)</td>
</tr>
<tr>
<td>polydipsia</td>
<td>Excessive thirst</td>
</tr>
<tr>
<td>polyuria</td>
<td>Elimination of large amounts of urine, as in diabetes mellitus</td>
</tr>
<tr>
<td>retention of urine</td>
<td>Accumulation of urine in the bladder because of an inability to urinate</td>
</tr>
<tr>
<td>staghorn calculus</td>
<td>A kidney stone that fills the renal pelvis and calices to give a “staghorn” appearance (Fig. 13-16)</td>
</tr>
<tr>
<td>ureterocele</td>
<td>A cyst-like dilation of the ureter near its opening into the bladder. Usually results from a congenital narrowing of the ureteral opening (Fig. 13-17)</td>
</tr>
<tr>
<td>urinary frequency</td>
<td>A need to urinate often without an increase in average output</td>
</tr>
<tr>
<td>urinary incontinence</td>
<td>Inability to retain urine; may originate with a neurologic disorder, trauma to the spinal cord, weakness of the pelvic muscles, urinary retention, or impaired bladder function. In urgency incontinence, an urge causes sudden urination before one has enough time to reach a bathroom. In stress incontinence, urine leaks during a forceful activity such as coughing, sneezing, or exercise</td>
</tr>
<tr>
<td>urinary urgency</td>
<td>Sudden need to urinate</td>
</tr>
<tr>
<td>water intoxication</td>
<td>Excess intake or retention of water with decrease in sodium concentration. May result from excess drinking, excess ADH, or replacement of a large amount of body fluid with pure water. Causes an imbalance in the cellular environment, with edema and other disturbances</td>
</tr>
<tr>
<td>Wilms tumor</td>
<td>A malignant kidney tumor that usually appears in children before the age of 5 years</td>
</tr>
</tbody>
</table>

### Diagnosis

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>anion gap</td>
<td>A measure of electrolyte imbalance</td>
</tr>
<tr>
<td>blood urea nitrogen (BUN)</td>
<td>Nitrogen in the blood in the form of urea. An increase in BUN indicates an increase in nitrogenous waste products in the blood and renal failure</td>
</tr>
<tr>
<td>clean-catch specimen</td>
<td>A urine sample obtained after thorough cleansing of the urethral opening and collection in midstream to minimize the chance of contamination</td>
</tr>
<tr>
<td>cystometry (uro-tou-mé-TOH-gra-fe)</td>
<td>A study of bladder function in which the bladder is filled with fluid or air and the pressure exerted by the bladder muscle at varying degrees of filling is measured. The tracing recorded is a cystometry graph</td>
</tr>
<tr>
<td>protein electrophoresis (PEP)</td>
<td>Laboratory study of urinary proteins; used to diagnose multiple myeloma, systemic lupus erythematosus, and lymphoid tumor</td>
</tr>
<tr>
<td>urinometer</td>
<td>Device for measuring the specific gravity of urine</td>
</tr>
</tbody>
</table>
### Supplementary Terms (Continued)

**Treatment**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>indwelling Foley catheter</td>
<td>A urinary tract catheter with a balloon at one end that prevents the catheter from leaving the bladder (see Fig. 13-5)</td>
</tr>
<tr>
<td>lithotrite</td>
<td>Instrument for crushing a bladder stone</td>
</tr>
</tbody>
</table>

**PASSport to Success**

Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these words pronounced.

---

**Figure 13-13** *Horseshoe kidney.* The photograph shows the kidneys fused at the poles.

**Figure 13-14** *Hypospadias.* The urethra is shown opening on the ventral surface of the penis.

**Figure 13-15** *Adult polycystic disease.* The kidney is enlarged, and the active tissue is almost entirely replaced by cysts of varying size. (Left) Surface view. (Right) Longitudinal section.
Figure 13-16  Staghorn calculus. The kidney shows hydronephrosis and stones that are casts of the dilated calices.

Figure 13-17  Ureteroceles. The ureter bulges into the bladder. The resulting obstruction causes urine to reflux into the ureter (hydronephrosis) and renal pelvis (hydronephrosis).

**Terminology**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE</td>
<td>Angiotensin-converting enzyme</td>
</tr>
<tr>
<td>ADH</td>
<td>Antidiuretic hormone</td>
</tr>
<tr>
<td>ARF</td>
<td>Acute renal failure</td>
</tr>
<tr>
<td>ATN</td>
<td>Acute tubular necrosis</td>
</tr>
<tr>
<td>BUN</td>
<td>Blood urea nitrogen</td>
</tr>
<tr>
<td>CAPD</td>
<td>Continuous ambulatory peritoneal dialysis</td>
</tr>
<tr>
<td>CCPD</td>
<td>Continuous cyclic peritoneal dialysis</td>
</tr>
<tr>
<td>CMG</td>
<td>Cystometryrography; cystometryrogram</td>
</tr>
<tr>
<td>CRF</td>
<td>Chronic renal failure</td>
</tr>
<tr>
<td>EPO</td>
<td>Erythropoietin</td>
</tr>
<tr>
<td>ESRD</td>
<td>End-stage renal disease</td>
</tr>
<tr>
<td>ESWL</td>
<td>Extracorporeal shock wave lithotripsy</td>
</tr>
</tbody>
</table>

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFR</td>
<td>Glomerular filtration rate</td>
</tr>
<tr>
<td>GU</td>
<td>Genitourinary</td>
</tr>
<tr>
<td>IVP</td>
<td>Intravenous pyelography</td>
</tr>
<tr>
<td>IVU</td>
<td>Intravenous urography</td>
</tr>
<tr>
<td>K</td>
<td>Potassium</td>
</tr>
<tr>
<td>KUB</td>
<td>Kidney-ureter-bladder (radiography)</td>
</tr>
<tr>
<td>Na</td>
<td>Sodium</td>
</tr>
<tr>
<td>PEP</td>
<td>Protein electrophoresis</td>
</tr>
<tr>
<td>SG</td>
<td>Specific gravity</td>
</tr>
<tr>
<td>Tm</td>
<td>Maximal transport capacity</td>
</tr>
<tr>
<td>UA</td>
<td>Urinalysis</td>
</tr>
<tr>
<td>UTI</td>
<td>Urinary tract infection</td>
</tr>
</tbody>
</table>
E.O.’s Follow-Up Study

E.O. had excellent results from the implanted autograft of muscle cells. There was no retention of urine, and the incontinence and urgency had all but disappeared. After a year, E.O. continued to experience about a 95 percent success rate from her stress incontinence and had a much improved quality of life score.
Labeling Exercise

**URINARY SYSTEM**

Write the name of each numbered part on the corresponding line of the answer sheet.

<table>
<thead>
<tr>
<th>Number</th>
<th>Diagram Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1</td>
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<tr>
<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<td>5.</td>
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<td>6.</td>
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<td>7.</td>
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<td>9.</td>
<td>9</td>
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<tr>
<td>10.</td>
<td>10</td>
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<tr>
<td>11.</td>
<td>11</td>
</tr>
<tr>
<td>12.</td>
<td>12</td>
</tr>
</tbody>
</table>
THE KIDNEY

Write the name of each numbered part on the corresponding line of the answer sheet.

1. Calyx
2. Hilum
3. Nephrons
4. Pyramids of medulla
5. Renal capsule
6. Renal medulla
7. Renal pelvis
8. Renal cortex
9. Ureter

THE URINARY BLADDER

Write the name of each numbered part on the corresponding line of the answer sheet.

1. External urethral sphincter
2. Smooth muscle
3. Internal urethral sphincter
4. Trigone
5. Openings of ureters
6. Ureter
7. Prostate
8. Urethra
Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

1. hematuria
2. oliguria
3. chromaturia
4. albuminuria
5. pyuria
6. trigone
7. catheterization
8. stasis
9. cystitis
10. uropenia

a. abnormal color of urine
b. pus in the urine
c. elimination of small amounts of urine
d. blood in the urine
e. proteinuria
f. absence of a bladder
f. stagnation, as of urine
g. deficiency of urine
h. triangle at the base of the bladder
i. introduction of a tube

Supplementary Terms

11. aldosterone
12. diabetes insipidus
13. incontinence
14. nocturia
15. creatinine
16. anuresis
17. epispidias
18. polydipsia
19. enuresis
20. azoturia

a. urination during the night
b. condition caused by lack of ADH
c. nitrogenous metabolic waste
d. hormone that regulates electrolytes
e. inability to retain urine
f. excessive thirst
f. bed-wetting
g. presence of excess nitrogenous waste in the urine
h. congenital misplacement of the ureteral opening
i. lack of urination

FILL IN THE BLANKS

21. A microscopic working unit of the kidney is called a(n) ____________________________.

22. The cluster of capillaries within the glomerular capsule is the ________________________.

23. An enzyme released by the kidneys that acts to increase blood pressure __________________________.

24. Micturition is the scientific term for ____________________________________________.

25. Laboratory study of the urine is a(n) ____________________________.

26. The main nitrogenous waste product in urine is ____________________________.

Referring to E.O.’s opening case study:

27. E.O.’s inability to retain urine is termed urinary ____________________________.

28. A midstream urine sample collected after thorough cleansing of the urethral opening is called a(n) ____________________________.

29. Endoscopic examination of the urinary bladder is termed ____________________________.
TRUE—FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

30. A reniform structure is shaped like the bladder.  
   True or False  
   Correct Answer

31. Pyelitis is inflammation of the renal pelvis.  
   True or False  
   Correct Answer

32. A nephrotropic substance acts on the kidney.  
   True or False  
   Correct Answer

33. The outer portion of the kidney is the medulla.  
   True or False  
   Correct Answer

34. The tube that carries urine out of the body is the ureter.  
   True or False  
   Correct Answer

35. EPO stimulates the production of red blood cells.  
   True or False  
   Correct Answer

36. A lithotomy is an incision to remove a calculus.  
   True or False  
   Correct Answer

37. Kaliuresis refers to the excretion of sodium in the urine.  
   True or False  
   Correct Answer

DEFINITIONS

Define the following words:

38. pararenal (par-a-RE-nal)

39. dysuria (dis-ú-ri-a)

40. nephrotropic (nef-rot-TOK-sik)

41. juxtaglomerular (juks-ta-glo-MER-ə-lar)

42. calicectomy (kal-i-SEK-tō-mē)

43. urethrostenosis (ū-re-thro-strē-No-sis)

Write a word for the following definitions:

44. dilatation of the renal pelvis and calices

45. softening of a kidney (neph’r/o)

46. excision of the bladder (cyst’o)

47. any disease of the kidney (neph’r/o)

48. radiograph of the bladder (cyst’o) and urethra

49. plastic repair of a ureter and renal pelvis

50. inflammation of the renal pelvis and the kidney

51. surgical creation of an opening between a ureter and the sigmoid colon

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

52. capsule — cast — pyramid — nephron — cortex

53. nephron loop — distal convoluted tubule — glomerular capsule — calyx — proximal convoluted tubule

54. ileal conduit — specific gravity — dialysis — cystoscopy — lithotripsy
OPPOSITES
Write a word that means the opposite of the following:
55. hydration
56. hypervolemia
57. diuretic
58. hyponatremia
59. ureasis

ADJECTIVES
Write the adjective form of the following:
60. calyx
61. urology
62. uremia
63. diuresis
64. nephrosis
65. ureter
66. urethra

PLURALS
Write the plural form of the following:
67. pelvis
68. calyx
69. glomerulus

WORD BUILDING
Write a word for the following definitions using the word parts given.
graph- ren/o -al intra- vesic/o -y ur/o inter- lith log supra-
70. radiographic study of the urinary tract
71. pertaining to the kidney
72. within the kidney
73. radiographic study of the kidney
74. within the bladder
75. above the kidney
76. study of the urinary tract
77. between the kidneys
78. pertaining to the bladder
79. a urinary tract stone
ABBREVIATIONS
Write the meaning of the following abbreviations:
80. IVP ____________________________
81. ADH ____________________________
82. EPO ____________________________
83. IVU ____________________________
84. Na ____________________________
85. GFR ____________________________
86. UA ____________________________

WORD ANALYSIS
Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.
87. hemodialysis (hē-mō-di-AL-i-sis)
   a. hem/o ____________________________
   b. dia- ____________________________
   c. lysis ____________________________
88. cystometrygraphy (sis-tō-me-TROG-ra-fe)
   a. cyst/o ____________________________
   b. metr/o ____________________________
   c. -graphy ____________________________
89. ureteroneocystostomy (ū-re-ter-ō-ne-o-sis-TOS-to-me)
   a. ureter/o ____________________________
   b. neo- ____________________________
   c. cyst/o ____________________________
   d. -stomy ____________________________

thePoint: For more learning activities, see Chapter 13 of the Student Resources on thePoint.
Case Study 13-1: Renal Calculi

A.A., a 48-YO woman, was admitted to the inpatient unit from the ER with severe right flank pain unresponsive to analgesics. Her pain did not decrease with administration of 100 mg of IV meperidine. She had a three-month history of chronic UTI. Six months ago, she had been prescribed calcium supplements for low bone density. Her gynecologist warned her that calcium could be a problem for people who are “stone formers.” A.A. was unaware that she might be at risk. An IV urogram showed a right staghorn calculus. The diagnosis was further confirmed by a renal ultrasound. A renal flow scan showed normal perfusion and no obstruction. Kidney function was 37 percent on the right and 63 percent on the left. The pain became intermittent, and A.A. had no hematuria, dysuria, frequency, urgency, or nocturia. Urinalysis revealed no albumin, glucose, bacteria, or blood; there was evidence of cells, crystals, and casts.

A.A. was transferred to surgery for a cystoscopic ureteral laser lithotripsy, insertion of a right retrograde ureteral catheter, and right percutaneous nephrolithotomy. A ureteral calculus was fragmented with a pulsed-dye laser. Most of the staghorn was removed from the renal pelvis with no remaining stone in the renal calices. She was discharged two days later and ordered to strain her urine for the next week for evidence of stones.

Case Study 13-2: End-Stage Renal Disease

M.C., a 20-YO part-time college student, has had chronic glomerulonephritis since age 7. He has been treated at home with CAPD for the past 16 months as he awaits kidney transplantation. His doctor advised him to go immediately to the ER when he reported chest pain, shortness of breath, and oliguria. On admission, M.C. was placed on oxygen and given a panel of blood tests and an ECG to rule out an acute cardiac episode. His hemoglobin was 8.2, and his hematocrit was 26 percent. He had bilateral lung rales. ABGs were: pH, 7.0; Paco2, 28; Pao2, 50; HCO3, 21. His BUN, serum creatinine, and BUN/creatinine ratio were abnormally high. His ECG and liver enzyme studies were normal. His admission diagnosis was ESRD, fluid overload, and metabolic acidosis. He was typed and crossed for blood; tested for HIV, hepatitis B antigen, and sexually transmitted disease; and sent to hemodialysis. A bed was reserved for him on the transplant unit.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

____ 1. The term perfusion means:
   a. size
   b. shape
   c. passage of fluid
   d. surrounding tissue
   e. metabolism

____ 2. The term percutaneous means:
   a. under the skin
   b. on the surface
   c. with a catheter
   d. by chemicals
   e. through the skin

____ 3. M.C.’s chronic glomerulonephritis means that he has had:
   a. long-term kidney stones
   b. an acute bout of kidney infection
   c. short-term bladder inflammation
   d. a long-term kidney infection
   e. dysuria for 13 years

____ 4. Renal dialysis can be performed by shunting venous blood through a dialysis machine and returning the blood to the patient’s arterial system. This procedure is called:
   a. hemodialysis
   b. arteriovenous transplant
   c. CAPD
   d. phlebotomy
   e. glomerular filtration rate
Write a term from the case studies with the following meanings:

5. intravenous injection of contrast dye and radiographic study of the urinary tract

6. presence of blood in the urine

7. referring to endoscopy of the urinary bladder

8. surgical incision for removal of a kidney stone

9. production of a reduced amount of urine

10. getting up to go to the bathroom at night

11. crushing a stone

12. kidney replacement

Abbreviations. Define the following abbreviations:

13. UTI

14. CAPD

15. BUN

16. ESRD

17. HIV