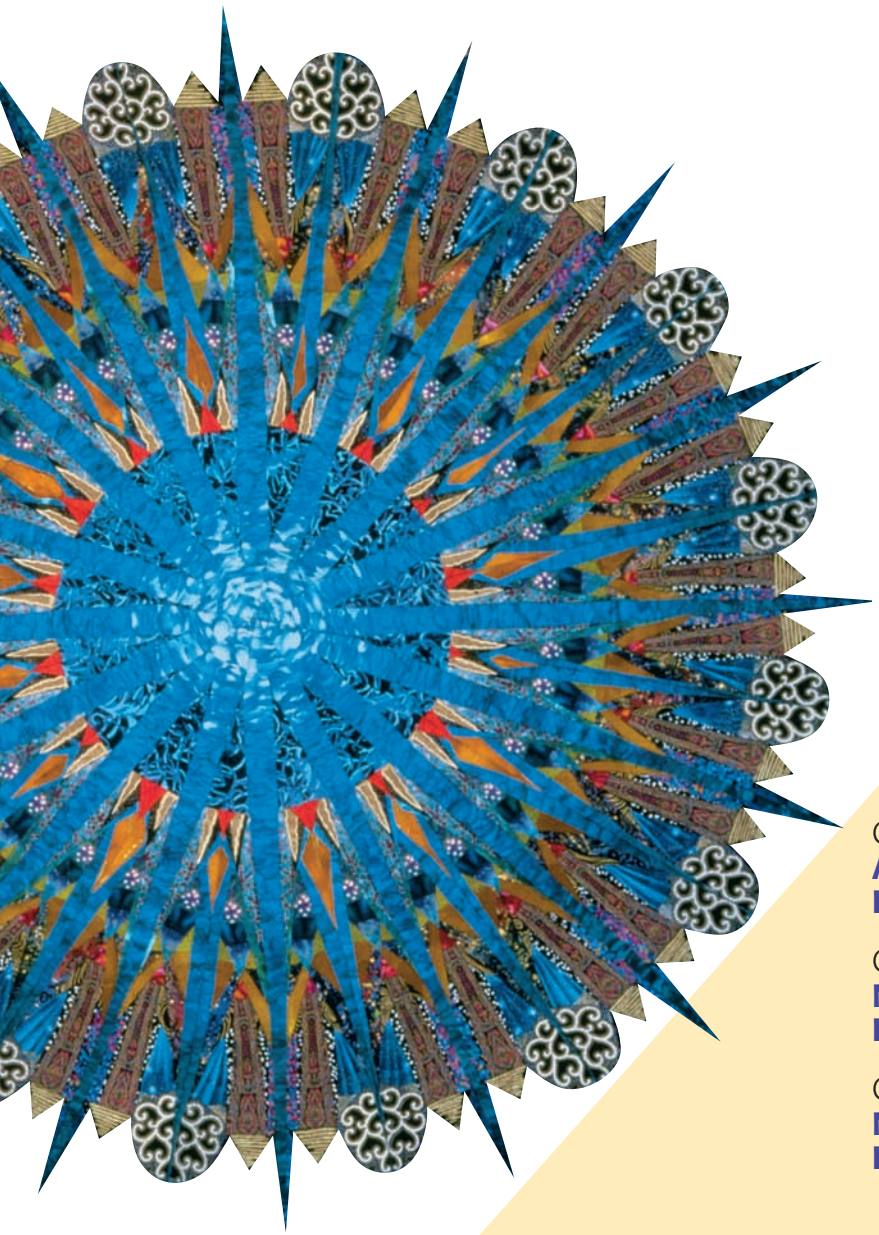
Responses to Altered Urinary Elimination

UNIT 8



CHAPTER 27
Assessing Clients with Urinary Elimination Disorders

CHAPTER 28
Nursing Care of Clients with Urinary Tract Disorders

CHAPTER 29
Nursing Care of Clients with Kidney Disorders

CHAPTER 27 Assessing Clients with Urinary Elimination Disorders

LEARNING OUTCOMES

- Describe the anatomy, physiology, and functions of the urinary system.
- Explain the role of the urinary system in maintaining homeostasis.
- Identify specific topics for consideration during a health history assessment interview of the client with health problems involving the urinary system.
- Describe techniques used to assess the integrity and function of the urinary system.
- Describe normal variations in assessment findings for the older adult.
- Identify manifestations of impairment of the urinary system.

CLINICAL COMPETENCIES

- Conduct and document a health history for clients who have or are at risk for alterations in urinary elimination.
- Conduct and document a physical assessment of the urinary system.
- Monitor the results of diagnostic tests and report abnormal findings.

EQUIPMENT NEEDED

- Urine specimen cup
- Disposable gloves
- Stethoscope

MEDIALINK

Resources for this chapter can be found on the Prentice Hall Nursing MediaLink DVD-ROM accompanying this textbook, and on the Companion Website at http://www.prenhall.com/lemone

KEY TERMS

calculi, *838*
dysuria, *839*
glomerular filtration rate (GFR), *831*
hematuria, *839*
micturition, *834*
nocturia, *839*
oliguria, *839*
polyuria, *839*
pyuria, *839*
urea, *834*

The functions of the urinary system (also called the renal system) are to regulate body fluids, to filter metabolic wastes from the bloodstream, to reabsorb needed substances and water into the bloodstream, and to eliminate metabolic wastes and water as urine. Any alteration in the structure or function of the urinary system affects the whole body. In turn, healthy urinary system function depends on the health of other body systems, especially the circulatory, endocrine, and nervous systems.

ANATOMY, PHYSIOLOGY, AND FUNCTIONS OF THE URINARY SYSTEM

The organs of the urinary system are the paired kidneys, the paired ureters, the urinary bladder, and the urethra (Figure 27–1 ■). Each structure is essential to the total functioning of the urinary system.

The Kidneys

The two kidneys are located outside the peritoneal cavity and on either side of the vertebral column at the levels of T_{12}

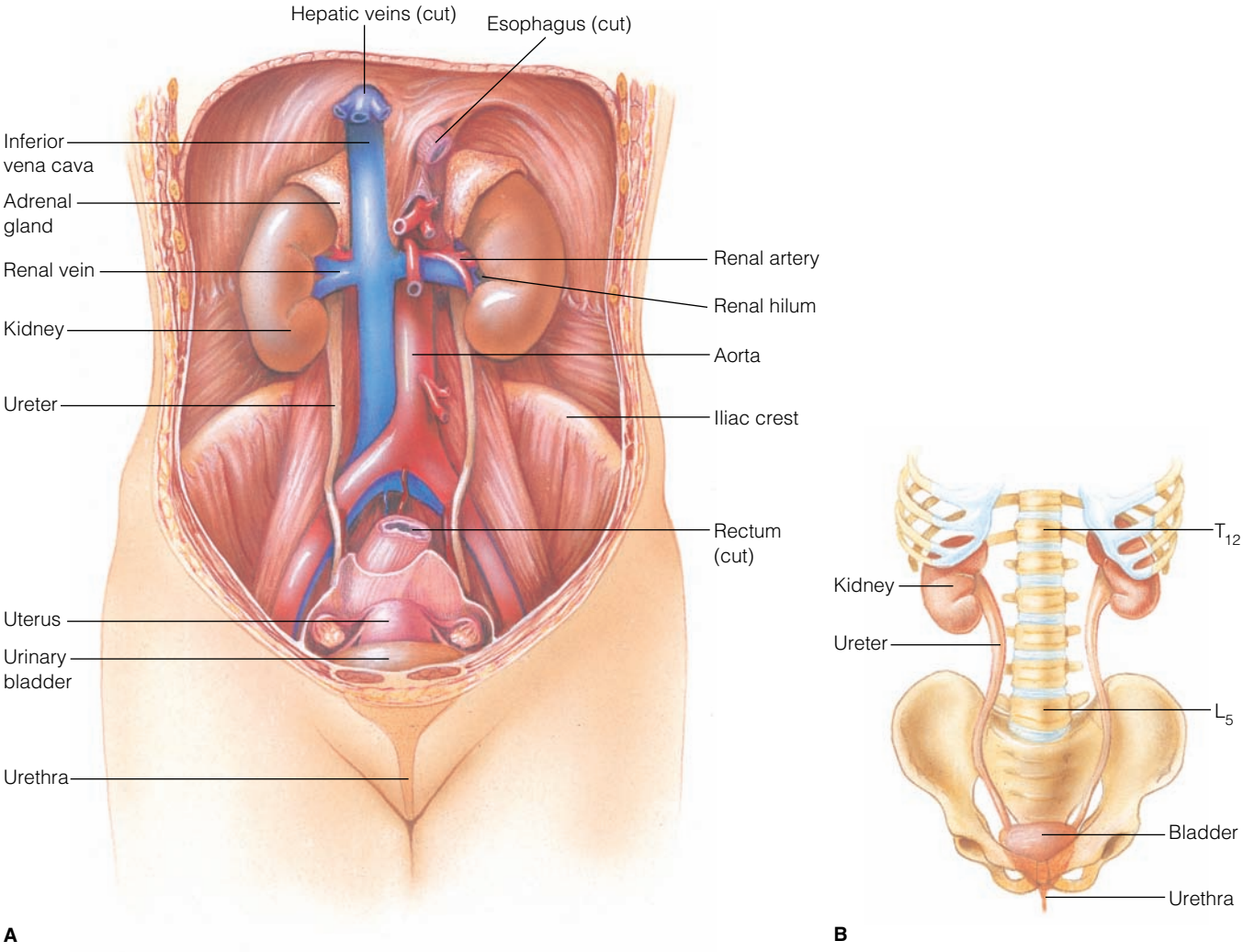


Figure 27–1 ■ The urinary system. *A,* Anterior view of the urinary system in a female. *B,* The kidneys are shown in relation to the vertebrae and ribs.

through L_3. These highly vascular, bean-shaped organs are approximately 4.5 inches (11.4 cm) long and 2.5 inches (6.4 cm) wide. The lateral surface of the kidney is convex; the medial surface is concave and forms a vertical cleft, the hilum. The ureter, renal artery, renal vein, lymphatic vessels, and nerves enter or exit the kidney at the level of the hilum.

The kidney is supported by three layers of connective tissue: the outer renal fascia, the middle adipose capsule, and the inner renal capsule. The renal fascia, made up of dense connective tissue, surrounds the kidney (and the adrenal gland, a discrete organ that sits on top of each kidney) and anchors it to surrounding structures. The middle adipose capsule is a fatty mass that holds the kidney in place and also cushions it against trauma. The inner renal capsule provides a barrier against infection and helps protect the kidney from trauma.

Internally, each kidney has three distinct regions: the cortex, medulla, and pelvis. The outer region, or renal cortex, is light in color and has a granular appearance (Figure 27–2 ■). This region of the kidney contains the glomeruli, small clusters of capillaries. The glomeruli bring blood to and carry waste products from the nephrons, the functional units of the kidney.

The renal medulla, just below the cortex, contains cone-shaped tissue masses called renal pyramids, formed almost entirely of bundles of collecting tubules. Areas of lighter colored tissue called renal columns are extensions of the cortex and serve to separate the pyramids. The collecting tubules that make up the pyramids channel urine into the innermost region, the renal pelvis.

The renal pelvis is continuous with the ureter as it leaves the hilum. Branches of the pelvis known as the major and minor calyces extend toward the medulla and serve to collect urine and empty it into the pelvis. From the pelvis, urine is channeled through the ureter and into the bladder for storage. The walls of the calyces, the renal pelvis, and the ureter contain smooth muscle that moves urine along by peristalsis.

Each kidney contains approximately 1 million nephrons, which process the blood to make urine (Figure 27–3 ■). Each nephron contains a tuft of capillaries called the glomerulus, which is completely surrounded by the glomerular capsule (or Bowman's space). Together, the glomerulus and its surrounding capsule are called the renal corpuscle. The endothelium of the glomerulus allows capillaries to be extremely porous. Thus, large amounts of solute-rich fluid pass from the capillaries into the capsule.

This fluid, called the filtrate, is the raw material of urine. Filtrate leaves the capsule and is channeled into the proximal convoluted tubule (PCT) of the nephron. Microvilli on the tubular cells increase the surface area for reabsorption of substances from the filtrate into plasma in the peritubular capillaries. Substances moved by active transport include glucose, sodium, potassium, amino acids, proteins, and vitamins. About 70% of the water in the filtrate, as well as chloride and bicarbonate, are reabsorbed by passive transport.

The filtrate then moves into the U-shaped loop of Henle and is concentrated. The descending limb of the U is relatively thin and freely permeable to water, whereas the ascending segment is thick and thereby less permeable. The distal convoluted tubule (DCT) receives filtrate from the loop of Henle. Although this segment is structurally similar to the PCT, it lacks microvilli and is more involved with secreting solutes into the filtrate than in reabsorbing substances from it. The collecting duct receives the newly formed urine from many nephrons and channels urine through the minor and major calyces of the renal pelvis and into the ureter.

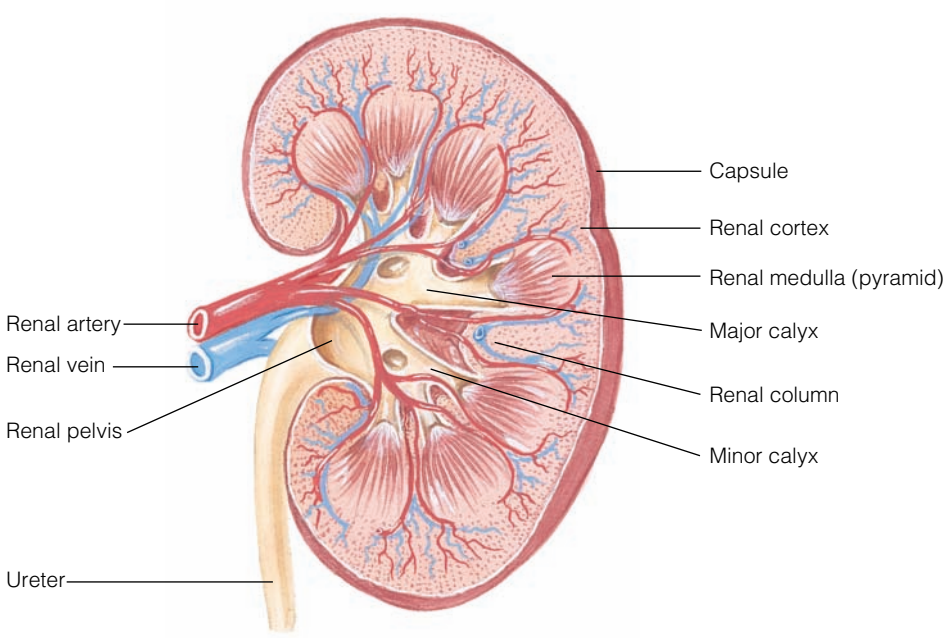


Figure 27–2 ■ Internal anatomy of the kidney.

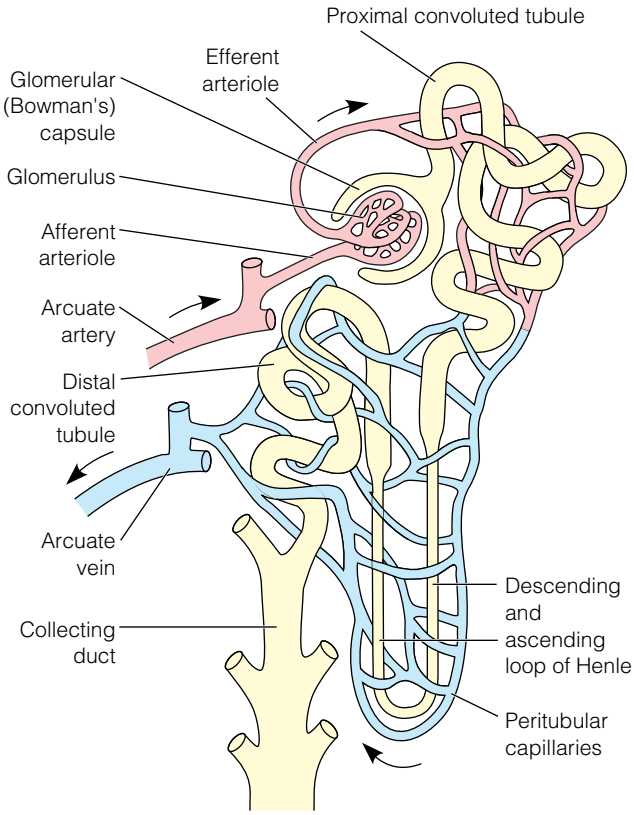


Figure 27–3 ■ The structure of a nephron, showing the glomerulus within the glomerular capsule.

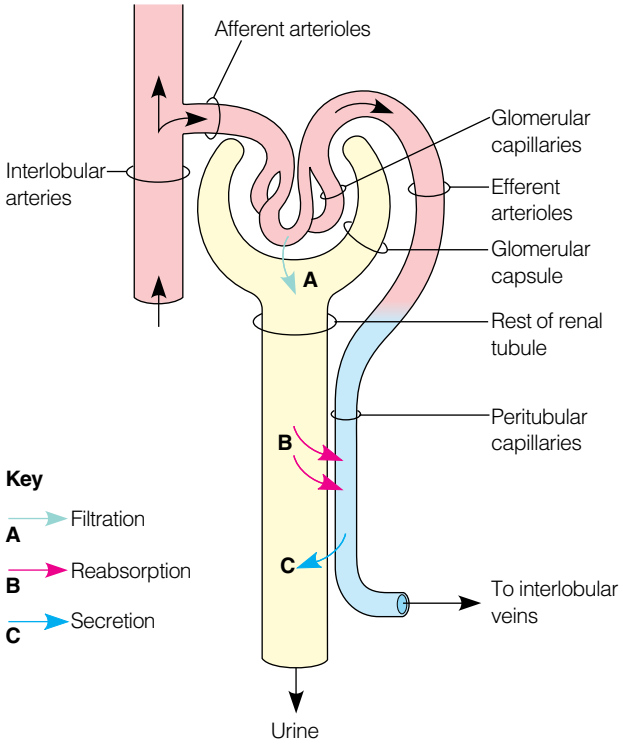


Figure 27–4 ■ Schematic view of the three major mechanisms by which the kidneys adjust to the composition of plasma: *A,* glomerular filtration; *B,* tubular reabsorption; and *C,* tubular secretion.

The functions of the kidney are to:

- Form urine.
- Balance solute and water transport.
- Excrete metabolic waste products.
- Conserve nutrients.
- Regulate acid–base balance.
- Secrete hormones to help regulate blood pressure, erythrocyte production, and calcium metabolism.

Formation of Urine

The complex structures of the kidneys process about 180 L (47 gal) of blood-derived fluid each day. Of this amount, only 1% is excreted as urine; the rest is returned to the circulation. (Normal and abnormal findings of urine on laboratory analysis are listed in Table 27–1.) Urine formation is accomplished entirely by the nephron through three processes: glomerular filtration, tubular reabsorption, and tubular secretion (Figure 27–4 ■).

GLOMERULAR FILTRATION Glomerular filtration is a passive, nonselective process in which hydrostatic pressure forces fluid and solutes through a membrane. The amount of fluid filtered from the blood into the capsule per minute is called the **glomerular filtration rate (GFR)**. Three factors influence this rate: the total surface area available for filtration, the permeability of the filtration membrane, and the net filtration pressure.

The glomerulus is a far more efficient filter than most capillary beds, because the filtration membrane of the glomerulus is much more permeable to water and solutes than are other capillary membranes. In addition, the glomerular blood pressure is much higher, resulting in higher net filtration pressure.

Net filtration pressure is responsible for the formation of filtrate and is determined by two forces: hydrostatic pressure ("push") and osmotic pressure ("pull"). The glomerular hydrostatic pressure pushes water and solutes across the membrane. This pressure is opposed by the osmotic pressure in the glomerulus (primarily the colloid osmotic pressure of plasma proteins in the glomerular blood) and the capsular hydrostatic pressure exerted by fluids within the glomerular capsule. The difference between these forces determines the net filtration pressure, which is directly proportional to the GFR.

The normal GFR in both kidneys is 120 to 125 mL/min in adults. This rate is held constant under normal conditions by intrinsic controls (or renal autoregulation). The myogenic mechanism, which responds to pressure changes in the renal blood vessels, controls the diameter of the afferent arterioles, thereby achieving autoregulation. An increase in systemic blood pressure causes the renal vessels to constrict, whereas a decline in blood pressure causes the afferent arterioles to dilate. These changes adjust the glomerular hydrostatic pressure and, indirectly, maintain the glomerular filtration rate.

Another intrinsic control of the GFR is the result of the rennin–angiotensin mechanism at work in the kidneys. Special cells known as the juxtaglomerular apparatus are located in the distal tubules and respond to slow filtrate flow by releasing chemicals that cause intense vasodilation of the afferent arterioles. Conversely, an increase in the flow of filtrate promotes vasoconstriction, decreasing the GFR. A drop in systemic

TABLE 27–1 **Normal and Abnormal Findings: Urinalysis**

CHARACTERISTIC OR COMPONENT	NORMAL RESULTS	ABNORMAL FINDING WITH POSSIBLE CAUSE
Color	Light straw to amber yellow	■ Red, dark, smoky color may be the result of blood in the urine (hematuria or menstrual blood). ■ Cloudy urine occurs from infection. ■ Colorless urine indicates very dilute urine, such as in overhydration, kidney disease, alcohol ingestion, or diabetes insipidus. ■ Very dark yellow urine indicates dehydration and/or fever. ■ Red or red brown urine may be caused by sulfisoxazole-phenazopyridine (Azo Gantrisin), phenytoin (Dilantin), cascara, chlorpromazine (Thorazine), docusate calcium and phenolphthalein (Doxidan); and by carrots, rhubarb, and food coloring. ■ Orange urine is caused by fever, urobilin, phenazopyridine (Pyridium), amidopyrine, nitrofurantoin, sulfonamides, carrots, beets, and food coloring. ■ Blue or green urine is caused by *Pseudomonas*, amitriptyline (Elavil), methylene blue, methocarbamol (Robaxin), and yeast concentrate. ■ Brown or black urine is caused by Lysol poisoning, melanin, bilirubin, methemoglobin, porphyrin, cascara, and injectable iron.
Appearance	Clear	■ Hazy or cloudy urine indicates bacteria, pus, RBCs, WBCs, phosphates, prostatic fluid spermatozoa, or urates. ■ Milky urine is the result of fats or pyuria. ■ Yellow foam results from bilirubin, bile, or severe cirrhosis of the liver. ■ A dark yellow to brownish color is seen with deficient fluid volume.
Odor	Aromatic	■ Ammonia smell increases as urine stands outside the body. ■ Urinary tract infection (UTI) causes a foul or unpleasant odor, depending on the causative organism. ■ Asparagus causes a distinctive odor. ■ Mousy odors result from phenylketonuria. ■ Sweet or fruity odors occur in starvation and diabetic ketoacidosis.
pH	4.5–8.0	■ <4.5: metabolic acidosis, respiratory acidosis, diet high in meat protein, ammonium chloride and mandelic acid. ■ >8.0: bacteriuria, UTI, antibiotics (neomycin, kanamycin), sulfonamides, sodium bicarbonate, acetazolamide (Diamox), potassium citrate.
Specific gravity	1.005–1.030	■ <1.005: diabetes insipidus, overhydration, renal disease, severe potassium deficit. ■ >1.030: dehydration, fever, diabetes mellitus, vomiting, diarrhea, contrast media.
Protein	2–8 mg/dL	■ >8 mg/dL: proteinuria, exercise, fever, stress, acute infection, kidney disease, lupus erythematosus, leukemia, multiple myeloma, cardiac disease, toxemia of pregnancy, septicemia, lead, mercury, neomycin, barbiturates, sulfonamides.
Glucose	Negative	■ >15 mg/dL or +4: diabetes mellitus, stroke, Cushing's syndrome, anesthesia, glucose infusions, severe stress, infections, ascorbic acid, aspirin, cephalosporins, and epinephrine.
Ketones	Negative	■ +1 to +3: ketoacidosis, starvation, high-protein diet.
RBCs	Rare	■ >2 per low-power field: kidney trauma, kidney diseases, renal calculi, cystitis, excess aspirin, anticoagulants, sulfonamides, menstrual contamination.
WBCs	3–4	■ >4 per low-power field: UTI, fever, strenuous exercise, kidney diseases.
Casts	Occasional hyaline	■ Fever, kidney diseases, heart failure.

blood pressure often triggers the juxtaglomerular cells to release renin. Rennin acts on a plasma globulin, angiotensinogen, to release angiotensin I, which is in turn converted to angiotensin II. As a vasoconstrictor, angiotensin II activates vascular smooth muscle throughout the body, causing systemic blood pressure to rise. Thus, the rennin–angiotensin mechanism is a factor in renal autoregulation, even though its main purpose is the control of systemic blood pressure.

Glomerular filtration is also under an extrinsic control mechanism through the sympathetic nervous system. During periods of extreme stress or emergency, sympathetic nervous system stimulation causes strong constriction of the afferent

arterioles and inhibits filtrate formation. The sympathetic nervous system also stimulates the juxtaglomerular cells to release renin, increasing systemic blood pressure.

TUBULAR REABSORPTION Tubular reabsorption is a transepithelial process that begins as the filtrate enters the proximal tubules. In healthy kidneys, virtually all organic nutrients such as glucose and amino acids are reabsorbed. However, the tubules constantly regulate and adjust the rate and degree of water and ion reabsorption in response to hormonal signals. Reabsorption may be active or passive. Substances reclaimed through active tubular reabsorption are usually moving against electrical and/or chemical gradients. These substances, including glucose, amino acids, lactate, vitamins, and most ions, require an ATP-dependent carrier to be transported into the interstitial space. In passive tubular reabsorption, which includes diffusion and osmosis, substances move along their gradient without expenditure of energy.

TUBULAR SECRETION The final process in urine formation is tubular secretion, which is essentially reabsorption in reverse. Substances such as hydrogen and potassium ions, creatinine, ammonia, and organic acids move from the blood of the peritubular capillaries into the tubules themselves as filtrate. Thus, urine consists of both filtered and secreted substances. Tubular secretion is important for disposing of substances not already in the filtrate, such as medications. This process eliminates undesirable substances that have been reabsorbed by passive processes and rids the body of excessive potassium ions. It is also a vital force in the regulation of blood pH.

Maintaining Normal Composition and Volume of Urine

Maintaining the normal composition and volume of urine involves a countercurrent exchange system. In this system, fluid flows in opposite directions through the parallel tubes of the loop of Henle and the vasa recta, tiny capillaries that run along the loop of Henle. Fluid is exchanged across these parallel membranes in response to a concentration gradient (Figure 27–5 ■). When the filtrate enters the proximal convoluted tubule, its osmolality (at 300 mOsm/kg) is essentially the same as that of the plasma and the interstitial fluid of the renal cortex. Note the following steps in the process:

1. The descending loop of Henle is highly permeable to water and allows chloride and sodium to enter the loop through diffusion. The hyperosmotic interstitium causes

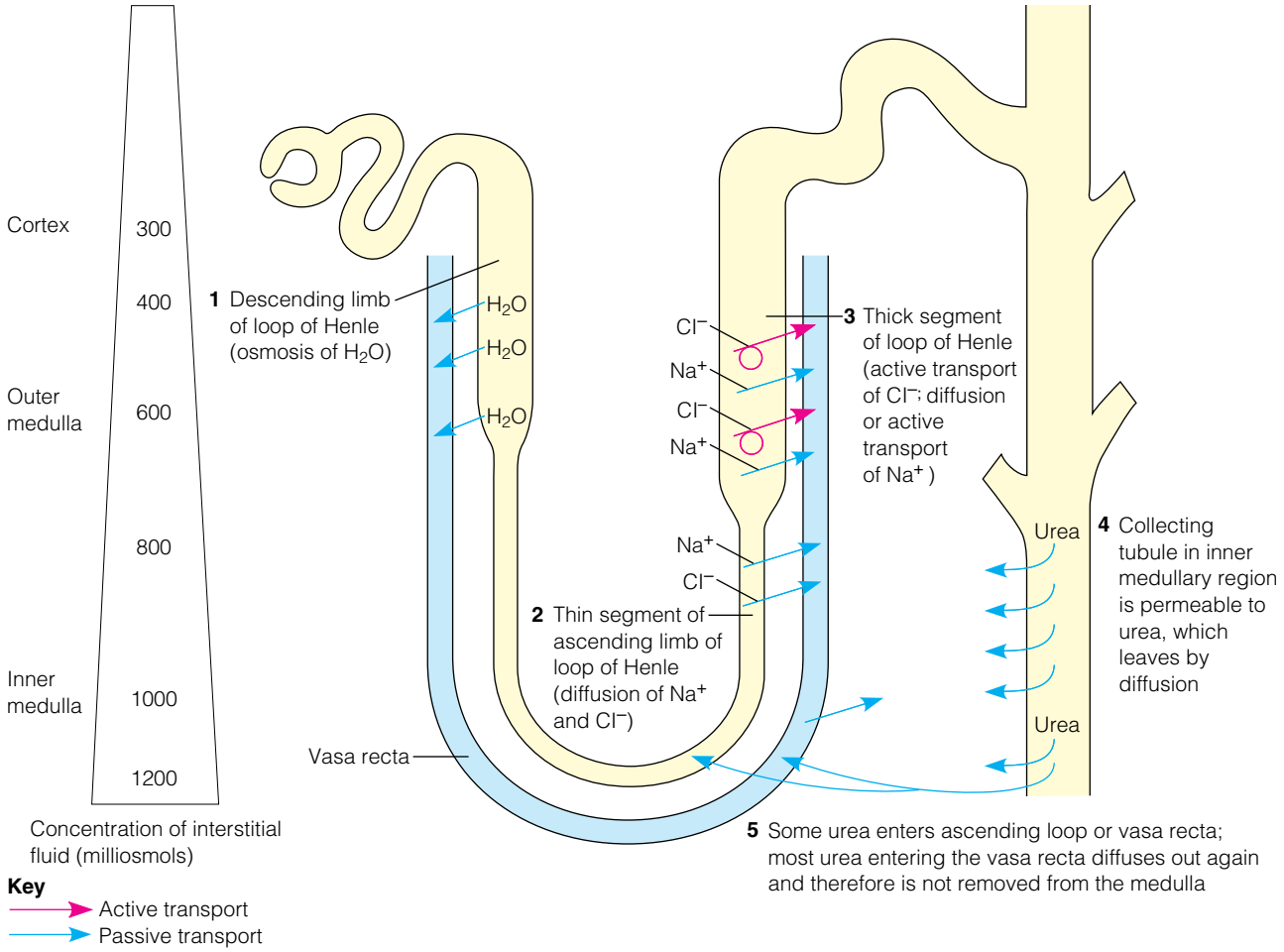


Figure 27–5 ■ The countercurrent exchange system is responsible for establishing and maintaining an osmotic gradient necessary to the composition, volume, and pH of urine.

water to move out of the descending loop, so that the remaining filtrate becomes increasingly concentrated.
2. The lumen of the ascending loop of Henle is impermeable to water but allows chloride and sodium to move out into the interstitium of the medulla. As a result, the filtrate in the ascending loop becomes hypoosmotic, and the medullary interstitium becomes hyperosmotic.
3. As the filtrate progresses through the ascending limb of the loop of Henle and enters the distal convoluted tubule, sodium and chloride are removed and water is retained. Thus, the filtrate becomes more dilute.
4. As the filtrate passes through the deep medullary regions, urea (an end product of protein metabolism and, along with water, the main constituent of urine) begins to diffuse out from the collecting tubules into the interstitial space and establishes a concentration gradient to facilitate water movement.
5. Some urea enters the ascending loop of Henle. Urea entering the vasa recta typically diffuses out again.

The dilution or concentration of urine is largely determined by the action of antidiuretic hormone (ADH), which is secreted by the posterior pituitary gland. ADH causes the pores of the collecting tubules to enlarge, so that increased amounts of water move into the interstitial space. As the end result, water is reabsorbed and urine is more highly concentrated. When ADH is not secreted, the filtrate passes through the system without further water reabsorption, so that the urine is more dilute.

Urine is composed, by volume, of about 95% water and 5% solutes. The largest component of urine by weight is urea. Other solutes normally excreted in the urine include sodium, potassium, phosphate, sulfate, creatinine, uric acid, calcium, magnesium, and bicarbonate.

Clearing Waste Products

The kidneys excrete water-soluble waste products and other chemicals or substances from the body. This process is called renal plasma clearance, which refers to the ability of the kidneys to clear (cleanse) a given amount of plasma of a particular substance in a given time (usually 1 minute). The kidneys clear 25 to 30 g of **urea** (a nitrogenous waste product formed in the liver from the breakdown of amino acids) each day. They also clear creatinine (an end product of creatine phosphate, found in skeletal muscle), uric acid (a metabolite of nucleic acid metabolism), and ammonia as well as bacterial toxins and water-soluble drugs. Tests of renal clearance are often used to determine the GFR and glomerular damage.

Renal Hormones

Hormones either activated or synthesized by the kidneys include the active form of vitamin D, erythropoietin, and natriuretic hormone.

Vitamin D is necessary for the absorption of calcium and phosphate by the small intestine. In an inactive form, vitamin D enters the body either by dietary intake or through the action of ultraviolet rays on cholesterol in the skin. Activation occurs in two steps, the first in the liver and the second in the kidneys. The renal step is stimulated by parathyroid hormone, which in turn responds to a decreased plasma calcium level.

Erythropoietin stimulates the bone marrow to produce red blood cells in response to tissue hypoxia. The stimulus for the production of erythropoietin by the kidneys is decreased oxygen delivery to kidney cells.

The right atria of the heart releases natriuretic hormone in response to increased volume and stretch, as occurs in increased extracellular volume. This hormone inhibits ADH secretion, so that the collecting tubules are less porous and a large amount of dilute urine is produced.

The Ureters

The ureters are bilateral tubes approximately 10 to 12 inches (26 to 30 cm) long. They transport urine from the kidney to the bladder through peristaltic waves originating in the renal pelvis. The wall of the ureter has three layers: an inner epithelial mucosa, a middle layer of smooth muscle, and an outer layer of fibrous connective tissue.

The Urinary Bladder

The urinary bladder is posterior to the symphysis pubis and serves as a storage site for urine. In males, the bladder lies immediately in front of the rectum; in females, the bladder lies in front of the vagina and the uterus. Openings for the ureters and the urethra are inside the bladder: The trigone is the smooth triangular portion of the base of the bladder outlined by these three openings (Figure 27–6 ■).

The layers of the bladder wall (from internal to external) are the epithelial mucosa lining the inside, the connective tissue submucosa, the smooth muscle layer, and the fibrous outer layer. The muscle layer, called the detrusor muscle, consists of fibers arranged in inner and outer longitudinal layers and in a middle circular layer. This arrangement allows the bladder to expand or contract according to the amount of urine it holds.

The size of the bladder varies with the amount of urine it contains. In healthy adults, the bladder holds about 300 to 500 mL of urine before internal pressure rises and signals the need to empty the bladder through **micturition** (also called urination

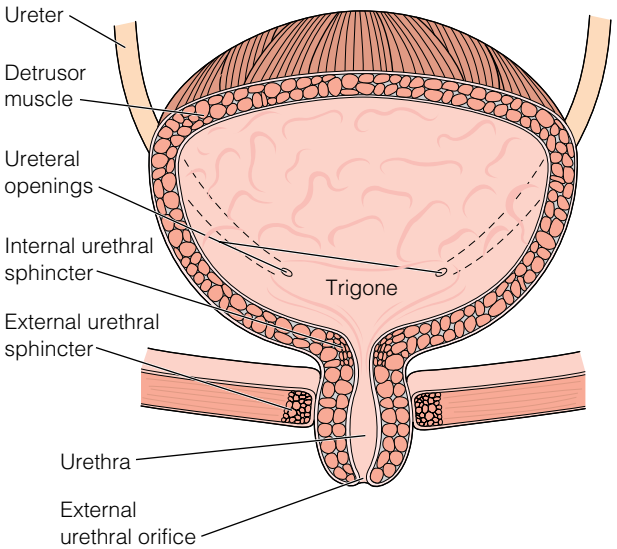


Figure 27–6 ■ Internal view of the urinary bladder and trigone.

or voiding). However, the bladder can hold more than twice that amount if necessary. The bladder has an internal urethral sphincter that relaxes in response to a full bladder and signals the need to urinate. A second external urethral sphincter is formed by skeletal muscle and is under voluntary control.

The Urethra

The urethra is a thin-walled muscular tube that channels urine to the outside of the body. It extends from the base of the bladder to the external urinary meatus. In females, the urethra is approximately 1.5 inches (3 to 5 cm) long, and the urinary meatus is anterior to the vaginal orifice. In males, the urethra is approximately 8 inches (20 cm) long and serves as a channel for semen as well as urine. The prostate gland encircles the urethra at the base of the bladder in males. The male urinary meatus is located at the end of the glans penis.

ASSESSING URINARY SYSTEM FUNCTION

Urinary system function is assessed by findings from diagnostic tests, a health assessment interview to collect subjective data, and a physical assessment to collect objective data. Sample documentation of an assessment of urinary system function is included in the box on this page.

SAMPLE DOCUMENTATION

Assessment of Urinary System Function

Home visit made to 66-year-old woman with end-stage chronic kidney failure. Skin pale and oral mucous membranes dry. 4+ edema in ankles and feet. Eyelids swollen. Skin tight and shiny over abdomen and bilateral lower extremities. Abdomen distended and tender on light palpation; further palpation deferred. Urinary bladder not palpable. Urine output for past 24 hours is 15 mL.

Diagnostic Tests

The results of diagnostic tests of urinary system function are used to support the diagnosis of a specific disease, to provide information to identify or modify the appropriate medication or therapy used to treat the disease, and to help nurses monitor the client's responses to treatment and nursing care interventions. Diagnostic tests to assess the structures and functions of the urinary system are described in the box below and summarized in the bulleted list that follows. More information is included in the discussion of specific disorders in Chapters 28 and 29.

DIAGNOSTIC TESTS of Urinary System Disorders

NAME OF TEST Blood urea nitrogen (BUN)

PURPOSE AND DESCRIPTION This blood test measures urea, the end product of protein metabolism. Increased levels may result from dehydration, vomiting, diarrhea, digested blood, or prerenal/renal failure.

Normal values: 5–25 mg/dL

RELATED NURSING CARE No special preparation is needed. If values are increased in a client who is dehydrated, they should return to normal with hydration. If not, this is an indicator of kidney disease.

NAME OF TEST Serum creatinine

PURPOSE AND DESCRIPTION This blood test is used to diagnose kidney dysfunction. Creatinine is a by-product of the breakdown of muscle and is excreted by the kidneys. When 50% or more nephrons are destroyed, serum creatinine levels rise.

Normal value: Serum: 0.5–1.5 mg/dL.

(Older adults may have decreased values due to decreased muscle mass.)

RELATED NURSING CARE No special preparation is needed. Values may be increased by antibiotics, ascorbic acid, L-dopa, methyldopa, and lithium carbonate. Value is not affected by hydration status.

NAME OF TEST Routine urinalysis (UA)

PURPOSE AND DESCRIPTION An examination of the constituents of a sample of urine to establish a baseline, to provide data for diagnosis, or to monitor results of treatment. Normal findings and abnormal findings with causes are outlined in Table 27–1.

RELATED NURSING CARE Provide a clean specimen cup for a sample of urine. Note if client is menstruating. Assess medications, fluid status, and foods that might affect urinalysis results.

NAME OF TEST Urine culture (midstream, clean-catch)

PURPOSE AND DESCRIPTION A culture of a urine sample to identify the causative organism of a UTI.

Normal value: <10,000 organisms/mL (urine is sterile but urethra contains bacteria and a few WBCs).

Values of >100,000 organisms/mL indicate UTI.

RELATED NURSING CARE Provide client with sterile container. Ask women to separate labia with one hand and clean labia with other hand, using sterile cotton sponges saturated with a cleansing solution, and wiping three times front to back. Ask men to retract the foreskin and cleanse glans with three cotton sponges saturated with a cleansing solution, using a circular motion. After cleaning, tell client to begin voiding and then collect specimen in the container (initial voiding will contain urethral contaminants). If client is unable to void, it may be necessary to obtain a specimen with a urinary catheterization.

(continued)

MEDIALINK Case Study: Urine Characteristics

DIAGNOSTIC TESTS of Urinary System Disorders (continued)

NAME OF TEST Residual urine (postvoiding residual urine)

PURPOSE AND DESCRIPTION Conducted to measure amount of urine left in the bladder after voiding.

Normal value: ≤50 mL

RELATED NURSING CARE Ask client to void in a collection device and measure the amount. Immediately after voiding, catheterize using aseptic technique and a straight catheter. Drain bladder completely. Document time, amount voided, amount obtained on catheterization, color, clarity, odor, and any other significant data. Report amount of residual urine if it is more than 100 mL. Document voiding amount and residual amount.

NAME OF TEST Portable ultrasonic bladder scan

PURPOSE AND DESCRIPTION Used to obtain information about residual urine. Warmed ultrasound gel is applied over the lower abdomen, and the ultrasound probe is placed just above the pubic bone. The scanner shows an outline of the bladder and displays the amount of urine in the bladder in milliliters. Obtain several readings and use the largest (the most accurate). Print the information, place it on the client's chart, and document the residual urine amount.

RELATED NURSING CARE No special preparation is needed, but the test is usually not used for pregnant women. Report a residual amount more than 100 mL.

NAME OF TEST Creatinine clearance

PURPOSE AND DESCRIPTION A 24-hour urine test to identify renal dysfunction and to monitor renal function.

Normal value: 85–135/min

Women and older adults may have slightly lower values.

RELATED NURSING CARE Assess medications: Phenacetin, steroids, and thiazides may decrease creatinine clearance; ascorbic acid, steroids, L-dopa, methyldopa (Aldomet), and cefoxitin may increase creatinine clearance. Levels of creatinine are elevated in hypothyroidism, hypertension, pregnancy, and exercise. Obtain appropriate specimen container. Ask client to void and discard first voiding. Instruct client, family, and staff to then save all urine for a clearly designated 24-hour period, maintaining the specimen in the container on ice or in the refrigerator.

NAME OF TEST Uroflowmetry

PURPOSE AND DESCRIPTION This test measures the volume of urine voided per second.

RELATED NURSING CARE Ask client to increase fluid intake and refrain from voiding for several hours before the test to ensure a full bladder and a strong urge to void during testing. Tell the client he or she will be asked to urinate into a funnel.

NAME OF TEST Cystometrogram (CMG) (voiding cystogram)

PURPOSE AND DESCRIPTION Conducted to evaluate bladder capacity and neuromuscular functions of the bladder, urethral pressures, and causes of bladder dysfunction. A measured quantity of fluid is instilled into the bladder, and the filling capacity and voiding pressures are measured.

Normal value: Urine stream strong and uninterrupted, normal filling pattern and sensation of fullness; bladder capacity: 300–600 mL; urge to void: >150 mL; fullness felt: 300 mL.

RELATED NURSING CARE Tell client that the bladder will be filled and during filling he or she will be asked to describe the first urge to void, and the sensation of being unable to delay urination any longer.

NAME OF TEST Intravenous pyelogram (IVP)

PURPOSE AND DESCRIPTION This radiologic examination is done to visualize the entire urinary tract to identify abnormal size, shape, and function of the kidneys or to detect renal calculi (stones), tumors, or cysts. A radiopaque substance is injected IV and a series of x-rays taken.

CLIENT PREPARATION

- Assess knowledge and understanding of procedure, clarifying information as needed.
- Schedule IVP prior to any ordered barium test or gallbladder studies using contrast material.
- Ask about allergy to seafood, iodine, or radiologic contrast dye. Notify physician or radiologist if allergies are known.
- Verify the presence of a signed consent for the procedure.
- Assess renal and fluid status, including serum osmolality, creatinine, and blood urea nitrogen (BUN) levels. Notify the physician of any abnormal values.
- Instruct the client to complete ordered pretest bowel preparation, including prescribed laxative or cathartic the evening before the test, and an enema or suppository the morning of the test. Withhold food for 8 hours prior to the test; clear liquids are allowed.
- Obtain baseline vital signs and record.

After the Test

- Monitor vital signs and urine output.
- Report manifestations of delayed reaction to the contrast media such as dyspnea, tachycardia, itching, hives, or flushing.

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- X-rays and a dye that is rapidly excreted in the urine are used to show the structures of the kidney, ureters, and bladder. The test takes about 30 minutes.
- A laxative and possibly an enema or suppository are used before the test to clear the bowel of feces and gas. Do not eat after the ordered time the evening before the test; you may drink clear fluids such as water, coffee, or tea (without creamer).
- As the dye is injected, you may feel a transient flushing or burning sensation, along with possible nausea and a metallic taste.
- Notify your doctor immediately if you develop a rash, difficulty breathing, rapid heart rate, or hives during or after the test.
- Increase fluid intake after the test is completed.

DIAGNOSTIC TESTS of Urinary System Disorders (continued)

NAME OF TEST Retrograde pyelogram

PURPOSE AND DESCRIPTION This radiologic test is done to evaluate the structures of the ureters and kidney pelvis. It may be performed alone or in conjunction with a cystoscopy. A contrast dye is injected through a catheter into the ureters and kidney pelvis and x-rays are taken.

RELATED NURSING CARE Nursing care for the client having a retrograde pyelogram is the same as that for clients having an IVP.

NAME OF TEST Renal arteriogram or angiogram

PURPOSE AND DESCRIPTION This radiologic test is done to visualize renal blood vessels in order to detect renal artery stenosis, renal thrombosis or embolism, tumors, cysts, or aneurysm; to determine the causative factor for hypertension; and to evaluate renal circulation. A contrast medium is injected into the femoral artery.

RELATED NURSING CARE Assess for allergy to iodine, seafood, or other contrast dye from other x-ray procedures. A laxative or cleansing enema is usually given the night before, and the client should be NPO for 8–12 hours prior to the test. Anticoagulants should be discontinued. Results may be affected by feces, gas, and barium sulfate. After the test, monitor for bleeding from the femoral artery, restrict activity for a day, assess peripheral pulses, and monitor urine output.

NAME OF TEST Cystoscopy (cystogram), cystography

PURPOSE AND DESCRIPTION Direct visualization of the bladder wall and urethra is accomplished by using a cystoscope. During the procedure small renal calculi can be removed from the ureter, bladder, or urethra, and tissue biopsy can be done. It also permits determination of the cause of hematuria or UTI. A stent may be inserted during the procedure to facilitate urinary drainage past an obstruction. A retrograde pyelogram may be done during the cystoscopy. By instilling a contrast dye into the bladder (*cystography*), neurogenic bladder, fistulas, tumors, or ruptures can be identified.

CLIENT PREPARATION

- Assess knowledge and understanding of the procedure, clarifying information as needed.
- Verify the presence of a signed consent for the procedure.
- Instruct in pretest preparation as ordered, including prescribed laxatives the evening prior to the test and any ordered food or fluid restrictions.
- Administer sedation and other medications as ordered prior to the test.

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- Cystoscopy is performed in a special cystoscopy room, using local or general anesthesia. You may feel some pressure or a need to urinate as the scope is inserted through the urethra into the bladder. The procedure takes approximately 30 to 45 minutes.
- Do not attempt to stand without assistance immediately after the procedure because you may feel dizzy or faint.
- Burning on urination for a day or two after the procedure is to be expected.
- Immediately notify the physician if your urine remains bloody for more than three voidings after the procedure, or if you develop bright bleeding, low urine output, abdominal or flank pain, chills, or fever.
- Warm sitz baths, analgesic agents, and antispasmodic medications may relieve discomfort after the procedure.
- Increase fluid intake to decrease pain and difficulty voiding and reduce the risk of infection.
- Laxatives may be ordered after the procedure to prevent constipation and straining, which may cause urinary tract bleeding.

NAME OF TEST Renal ultrasound

PURPOSE AND DESCRIPTION This noninvasive test is conducted to detect renal or perirenal masses, identify obstructions, and diagnose renal cysts and solid masses. It is done by applying a conductive gel to the skin and placing a small external ultrasound probe on the client's skin. Sound waves are recorded on a computer as they are reflected off tissues.

RELATED NURSING CARE No special preparation is indicated.

NAME OF TEST CT scan of kidneys

PURPOSE AND DESCRIPTION The CT scan allows evaluation of kidney size, tumors, abscesses, suprarenal masses, and obstructions. A contrast dye is injected IV, allowing increased visualization of the density of renal tissue and masses in comparison to an ultrasound.

RELATED NURSING CARE Assess the client for allergies to iodine, x-ray contrast dye, and seafood. Tell the client to remain NPO for 4 hours prior to the test, and that laxatives or enemas may be ordered to remove gas or fecal material from the bowel.

NAME OF TEST MRI of the kidneys

PURPOSE AND DESCRIPTION An MRI is used to visualize the kidneys by assessing computer-generated films of radiofrequency waves and changes in magnetic fields.

RELATED NURSING CARE Ask client to remove all metal objects. Assess for metal implants. (Test will not be conducted if present.)

NAME OF TEST Renal scan

PURPOSE AND DESCRIPTION This test is done to evaluate kidney blood flow, location, size, and shape; and to assess kidney perfusion and urine production. Radioactive isotopes are injected IV and radiation detector probes are placed over the kidneys to monitor activity in the kidneys. Radioisotope distribution in the kidneys is scanned and graphed. Nonfunctioning tissue, such as in tumors and cysts, appears as cold spots.

RELATED NURSING CARE Ask client to drink several glasses of water prior to the test. Obtain weight and have client void. After the procedure, increase fluid intake.

(continued)

DIAGNOSTIC TESTS of Urinary System Disorders (continued)

NAME OF TEST Renal biopsy

PURPOSE AND DESCRIPTION A renal biopsy is done to obtain tissue to diagnose or monitor kidney disease. The test is usually done by inserting a needle through the skin into the lower lobe of the kidney. It can also be done with CT or ultrasound guidance.

CLIENT PREPARATION

- Informed consent is required for a kidney biopsy. Answer questions and provide additional information as needed.
- Maintain NPO status from midnight before the procedure.
- Note hemoglobin and hematocrit prior to the procedure.
- If the procedure is to be performed at the bedside, obtain biopsy tray and other necessary supplies.
- Following procedure, apply a pressure dressing and position supine to help maintain pressure on the biopsy site.
- Monitor closely for bleeding during the first 24 hours after the procedure:
  a. Check vital signs frequently. Notify the physician of tachycardia, hypotension, or other signs of shock.
  b. Monitor biopsy site for bleeding.
  c. Check hemoglobin and hematocrit, comparing with preprocedure values.
  d. Observe for and report complaints of flank or back pain, shoulder pain (caused by diaphragmatic irritation if hemorrhage occurs), pallor, light-headedness.
  e. Monitor urine output for quantity and hematuria. Initial hematuria should clear within 24 hours.
- Monitor for other potential complications such as inadvertent penetration of the liver or bowel. Report abdominal pain, guarding, and decreased bowel sounds.
- Encourage fluids during the initial postprocedure period.

HEALTH EDUCATION FOR THE CLIENT AND FAMILY

- Local anesthesia is used at the injection site. The procedure may be uncomfortable but should not be painful.
- When the needle is inserted, you will be instructed not to breathe to prevent kidney motion.
- The entire procedure takes approximately 10 minutes.
- Avoid coughing during the first 24 hours after the procedure. Strenuous activity such as heavy lifting may be prohibited for approximately 2 weeks after the procedure.
- Report any manifestations of complications, such as hemorrhage or urinary tract infection, to the physician.

- Urine may be tested for characteristics and components through routine analysis, a urine culture, a postvoiding residual urine, and a 24-hour collection for creatinine. Results of these tests include findings to serve as baseline data, to support diagnosis of various health problems, to evaluate the ability to empty the bladder of urine, and to evaluate renal function.
- The ability to empty the urinary bladder of urine may be evaluated by an ultrasonic bladder scan to evaluate for residual urine, uroflowmetry to measure the volume of urine voided per second, and a cystometrogram (CMG) to evaluate bladder capacity, neuromuscular functions of the bladder, urethral pressures, and causes of bladder dysfunction.
- Radiologic examinations include an intravenous pyelogram, a retrograde pyelogram, and a renal arteriogram or angiogram. These examinations are useful in visualizing (via x-ray film) the urinary tract to identify abnormal size, shape, and function of the kidneys, the kidney pelvis, and ureters; and to detect renal **calculi** (stones), tumors, or cysts.
- A cystoscopy allows direct visualization of the bladder wall and urethra. During the procedure small stones can be removed, a sample of tissue may be taken for biopsy, and a retrograde pyelogram may be done at the same time. If a contrast dye is instilled in the bladder, fistulas, tumors, or ruptures can be identified.
- Noninvasive tests include a renal ultrasound, computed tomography (CT) scan, magnetic resonance imaging (MRI), and renal scan. These tests are used to identify and evaluate kidney size and structure, as well as renal or perirenal masses and obstructions. In addition, a renal scan may be used to evaluate kidney blood flow, perfusion, and urine production.
- A kidney biopsy is done to obtain tissue to diagnose or monitor kidney disease.

Regardless of the type of diagnostic test, the nurse is responsible for explaining the procedure and any special preparation needed, assessing for medication use that may affect the outcome of the tests, supporting the client during the examination as necessary, documenting the procedures as appropriate, and monitoring the results of the tests.

Genetic Considerations

When conducting a health assessment interview and physical assessment, it is important for the nurse to consider genetic influences on adult health. During the health assessment interview, ask about family members with health problems affecting kidney function, or of family members diagnosed with polycystic disease or diabetes mellitus. During the physical assessment, assess for any manifestations that might indicate a genetic disorder (see Genetic Considerations on the next page). If data are found to indicate genetic risk factors or alterations, ask about genetic testing and refer for appropriate genetic counseling and evaluation. Chapter 8 ∞ provides further information about genetics in medical-surgical nursing.

Health Assessment Interview

A health assessment interview to determine problems with urinary structure and function may be conducted during a health screening, may focus on a chief complaint (such as burning on urination or difficulty starting the stream when urinating), or may be part of a total health assessment. As with alterations in bowel function, clients with problems with urinary system func-

MEDIALINK Case Study: Renal Calculi

Genetic Considerations
Urinary System

- Adult polycystic kidney disease (APKD) is linked to a familial chromosome 16 disorder. The disease is characterized by large cysts in one or both kidneys and a gradual loss of kidney tissue with resultant chronic renal failure.
- Chronic renal failure may be a complication of type 1 and type 2 diabetes mellitus (DM), but is seen more often in clients with type 1 DM. Type 1 and type 2 DM are classified as multifactorial inheritance disorders because both genetic and environmental factors are necessary for onset of the disorder.

tion may be embarrassed to talk about urinary elimination patterns. It is often helpful to discuss less personal information first.

Current urinary status should include the following data.

- Color, odor, and amount of urine
- Difficulty initiating a stream of urine
- Frequency of urination
- Painful urination (**dysuria**)
- Excessive urination at night (**nocturia**)
- Blood in the urine (**hematuria**)
- Voiding scant amounts of urine (**oliguria**)
- Voiding excessive amounts of urine (**polyuria**)
- Discharge
- Flank pain.

If you identify a problem with urinary elimination, analyze its onset, characteristics and course, severity, precipitating and relieving factors, and any associated symptoms, noting the timing and circumstances. For example, you may ask the following questions:

- Have you noticed any burning when you urinate?
- Do you have difficulty starting to urinate?
- When did you first notice that you were unable to control the loss of urine from your bladder?

Further explore any abnormalities in the client's current urinary status. Focus questions on changes in patterns of urination, changes in the urine, and pain.

Assess changes in patterns of urination by asking the client: How many times a day do you urinate? Do you feel that you empty your bladder each time? How many times do you get up at night to urinate? Do you experience a very strong desire to urinate and feel that you just cannot wait? Have you noticed that you urinate small amounts of dark, strong-smelling urine?

Changes in the urine that should be explored include the presence of blood or a cloudy appearance of the urine. If the client has noticed blood, explore the use of medications (such as anticoagulants or dye-containing drugs) and other bleeding problems. Women may not understand that blood in the toilet or on toilet tissue after urination is normal during menstruation. Cloudy, foul-smelling urine often indicates infection (**pyuria**); ask the client about temperature elevations, chills, and general malaise. Cloudy urine in men may result from retrograde ejaculation (when semen is discharged into the bladder instead of from the penis) during intercourse.

If the client reports pain, explore its location, duration, and intensity. Kidney pain is experienced in the back and the costovertebral angle (the angle between the lower ribs and adjacent vertebrae) and may spread toward the umbilicus. Renal colic (pain in response to renal calculi moving through the ureter) is severe, sharp, stabbing, and excruciating; often it is felt in the flank, bladder, urethra, testes, or ovaries. Bladder and urethral pain is usually dull and continuous but may be experienced as spasms. The client with a distended bladder experiences constant pain increased by any pressure over the bladder.

Information about surgeries or other treatment of previous urinary problems is essential to the health history, as is a family history of altered structure or function. A family history of renal problems may be the first clue to abnormalities in the client's urinary function. Explore information regarding family occurrence of end-stage renal disease, renal calculi, and frequent infections as well as related problems such as hypertension and diabetes mellitus.

Questions about lifestyle, diet, and work history should explore cigarette smoking and/or exposure to toxic chemicals (to identify risks for cancer), usual fluid intake, type of fluid intake, and self-care measures to replace fluids lost during work or physical activity in hot temperatures.

Interview questions categorized by functional health patterns are listed in the box on the next page.

Physical Assessment

The structure and function of the urinary system is assessed by examination of the skin, abdomen, kidneys, bladder, and urinary meatus. Guidelines for abdominal assessment are outlined in both Chapters 21 and 25. Normal age-related findings for the older adult are summarized in Table 27–2.

Physical assessment of the urinary system may be performed as part of a total health assessment, as part of an abdominal assessment, or as part of the back examination (for the kidneys). The techniques of inspection, auscultation, palpation, and percussion are used.

PRACTICE ALERT
Auscultate immediately after inspection because percussion or palpation may increase bowel motility and interfere with sound transmission during auscultation.

Before beginning the assessment, ask the client to provide a clean-catch urine specimen and give the client a specimen cup. Assess the specimen for color, odor, and clarity before you send it to the laboratory.

At the beginning of the assessment, the client may be sitting or lying supine. Prior to the examination, collect all necessary equipment and explain the techniques to the client to decrease anxiety. Because the examination involves exposure of the genital area, give the client a gown and drape the client appropriately to minimize exposure.

Guidelines for percussion and palpation of the kidneys are outlined in Box 27–1.

FUNCTIONAL HEALTH PATTERN INTERVIEW **Urinary System**

Functional Health Pattern	Interview Questions and Leading Statements
Health Perception-Health Management	■ Have you ever had a bladder or kidney disease, injury, or surgery? Describe. ■ If so, how was the problem treated? ■ Describe your usual intake of fluids for a 24-hour period. What type of fluids do you drink? ■ Have you ever smoked? If so, how many cigarettes per day? ■ Describe the problem you are having with your kidneys or bladder. ■ Are you taking medications for this or any other health problem? If so, what do you take and how often? ■ *For women:* Describe how you care for yourself when you urinate (for example, direction of wiping with tissue). ■ If you have a surgical diversion of urine, describe how you care for yourself (what skin and appliance care do you do, how often do you empty the bag?). ■ Do you wear or have you ever worn an external catheter, indwelling catheter, or incontinence briefs? Explain. ■ Have you ever done self-catheterization? If so, why and how often?
Nutritional-Metabolic	■ How much coffee, tea, or alcohol do you drink in a 24-hour period? ■ Have you ever limited your fluid intake? Explain. ■ Do you limit the amount of salt you eat? Explain. ■ Do you have swelling in your ankles? If so, what do you do?
Elimination	■ How many times a day do you urinate? Do you have to get up at night to urinate? Has there been a change in your usual pattern of urination? ■ Do you experience a sudden urge to urinate? ■ Has there been a change in your urine, such as a change in amount, color, or odor? Have you ever noticed blood in your urine or on the tissue after you wipe? ■ Is it difficult for you to begin or end your flow of urine? ■ Have you ever had problems controlling your urine when you laugh, sneeze, or cough? ■ Do you have any discharge from your urethra? Explain.
Activity-Exercise	■ Do your urinary problems interfere with your activities of daily living? Explain. ■ Describe your usual energy level. Has there been a change? Explain. ■ Have you ever been taught to do Kegel exercises to help you control your urination? If so, how often do you practice these?
Sleep-Rest	■ Does a problem with urination interfere with your ability to sleep and rest? Explain. ■ Has there been a change in the number of times you wake up at night to urinate? Explain.
Cognitive-Perceptual	■ Do you have any pain or burning when you urinate? ■ Have you experienced any tenderness or pain over the lower sides of your back or severe pain that spreads over your lower abdomen? If so, describe its location, intensity, aggravating factors, and duration.
Self-Perception-Self-Concept	■ How does having this condition make you feel about yourself?
Role-Relationships	■ How does having this condition affect your relationships with others?
Sexuality-Reproductive	■ Has this condition interfered with your usual sexual activity?
Coping-Stress-Tolerance	■ Has having this condition created stress for you? ■ Have you experienced any kind of stress that makes this condition worse? Explain. ■ Describe what you do when you feel stressed.
Value-Belief	■ Describe how specific relationships or activities help you cope with this problem. ■ Describe specific cultural beliefs or practices that affect how you care for and feel about this problem. ■ Are there any specific treatments that you would not use to treat this condition?

TABLE 27–2 **Age-Related Urinary System Changes**

AGE-RELATED CHANGE	SIGNIFICANCE
Kidneys: ↓ size of renal cortex and number of nephrons, ↓ growth of renal tissue, ↑ risk of atherosclerosis, all of which may result in atrophy of the kidneys.	■ Decreased renal blood flow. ■ Decreased GFR by about 50% between ages 20 and 90.
Renal tubules: ↓ function, with less effective exchange of substances, water and sodium conservation and suppression of ADH secretion in presence of hypoosmolality.	■ Risk of hyponatremia and nocturia. ■ Effects of medications may be altered (with decreased filtration). ■ Decreased reabsorption of glucose may result in 1+ proteinuria and glycosuria, which are **not** of major clinical significance.
Bladder: ■ Muscles weaken and bladder capacity decreases. ■ More difficult to empty bladder. ■ Delayed micturition reflex.	■ Urinary retention is more common. ■ Urinary frequency, urgency, and nocturia are more common with aging. ■ Larger amounts of residual urine present after voiding. ■ Some stress incontinence may occur, especially in women who have had several children. ■ Urinary incontinence is not a normal outcome of aging.

BOX 27–1 **Guidelines for Physical Assessment of the Kidneys**

Percussion of the Kidneys

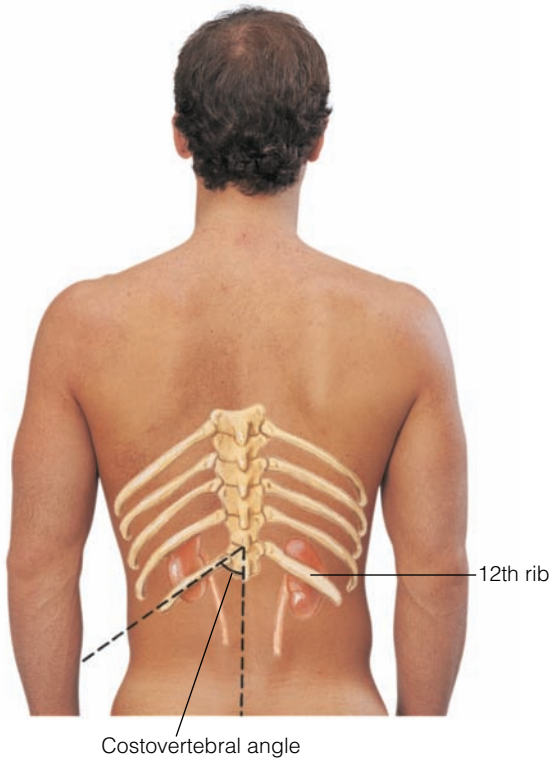
Percussion of the kidneys helps assess pain or tenderness. Assist the client to a sitting position, and stand behind the client. For indirect percussion, place the palm of your nondominant hand over the costovertebral angle (see Figure A). Strike this area with the ulnar surface of your dominant hand, curled into a fist (see Figure B). For direct percussion, also strike the area over the costovertebral angle with the ulnar surface of your dominant hand, curled into a fist. Repeat the technique for the other kidney.

You should do percussion of the kidneys with only enough force so the client feels a gentle thud. Percussion is usually done at the end of the assessment.

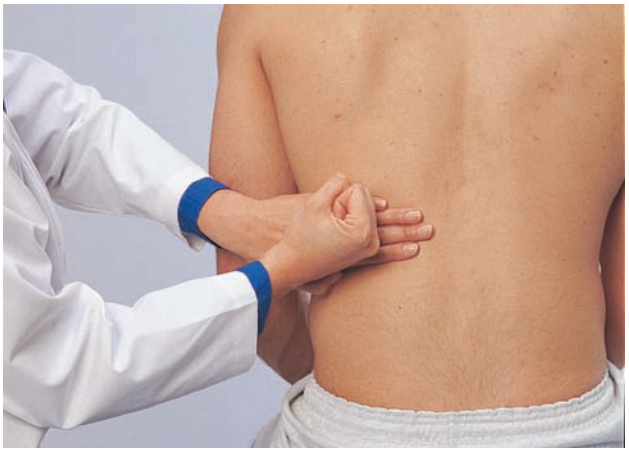
Palpation of the Kidneys

Although the technique of palpation of the kidneys is outlined here, this technique is best performed by an advanced practitioner, because it involves deep palpation. In addition, the kidneys are difficult to palpate.

Assist the client to the supine position and stand at the right side of the client. To palpate the left kidney, reach across the client and place your left hand under the client's left flank with your palm upward. Elevate the left flank with your fingers, displacing the kidney upward. Ask the client to take a deep breath and use the palmer surface of your right hand to palpate the kidney (Figure C). Repeat the technique for the right kidney.



A Location of the kidneys and the costovertebral angle.



B Percussing the kidney.

C Palpating the left kidney.

URINARY ASSESSMENTS

Technique/Normal Findings	Abnormal Findings

Skin Assessment

Inspect the skin and mucous membranes, noting color, turgor, and excretions. *The color of skin and mucous membranes should be even and appropriate to the age and race of the client; skin should be dry with no visible excretions.*

- Pallor of the skin and mucous membranes may indicate kidney disease with resultant anemia.
- Decreased turgor of the skin may indicate dehydration.
- Edema (generalized or in the lower extremities) may indicate fluid volume excess. (Changes in skin turgor may indicate renal insufficiency with either excess fluid loss or retention.)
- An accumulation of uric acid crystals, called uremic frost, may be seen on the skin of the client with late-stage renal failure.

Abdominal Assessment

Inspect the abdomen, noting size, symmetry, masses or lumps, swelling, distention, glistening, or skin tightness. *The abdomen should be slightly concave, symmetric, without distention or masses.*

- Enlargements or asymmetry may indicate a hernia or superficial mass.
- If the urinary bladder is distended, it rises above the symphysis pubis as a rounded mass.
- Distention, glistening, or skin tightness may be associated with fluid retention.
- Ascites is an accumulation of fluid in the peritoneal cavity.

Urinary Meatus Assessment

This technique is not part of a routine assessment, but it is an important component in clients with health problems of the urinary system. Further discussion is included in Chapter 49 ∞.

For the male client: **With the client in a sitting or standing position, compress the tip of the glans penis with your gloved hand to open the urinary meatus (Figure 27–7 ■).**

For the female client: **With the client in the dorsal lithotomy position, spread the labia with your gloved hand to expose the urinary meatus.**

The urinary meatus should be midline and free of redness, lesions, or discharge.

- Increased redness, swelling, or discharge from the urinary meatus may indicate infection or sexually transmitted infection.
- Ulceration of the urinary meatus may indicate a sexually transmitted infection.
- Hypospadias is displacement of the urinary meatus to the ventral surface of the penis.
- Epispadias is displacement of the urinary meatus to the dorsal surface of the penis.

Figure 27–7 ■ Inspecting the urinary meatus of the male.

Kidney Assessment

See Box 27–1 for assessment guidelines for percussion and palpation of the kidneys.

Auscultate the renal arteries by placing the bell of the stethoscope lightly in the areas of the renal arteries, located in the left and right upper abdominal quadrants. *Bruits are not normally heard over the renal arteries.*

- Systolic bruits ("whooshing" sounds) may indicate renal artery stenosis.

Technique/Normal Findings	Abnormal Findings
Percuss the kidneys for tenderness or pain. *No tenderness or pain should be elicited.*	■ Tenderness and pain on percussion of the costovertebral angle suggest glomerulonephritis or glomerulonephrosis.
Palpate the kidneys. The lower pole of the right kidney may be palpable with deep palpation; the remaining right kidney and the left kidney are normally not palpable. *If palpable, they should be nontender, bilaterally of appropriate size and density, without palpable masses.*	■ A mass or lump may indicate a tumor or cyst. ■ Tenderness or pain on palpation may suggest an inflammatory process. ■ A soft kidney that feels spongy may indicate chronic renal disease. ■ Bilaterally enlarged kidneys may suggest polycystic kidney disease. ■ Unequal kidney size may indicate hydronephrosis.
Bladder Assessment	
Percuss the bladder for tone and position. *The bladder should be midline without dullness.*	■ A dull percussion tone over the bladder of a client who has just urinated may indicate urinary retention.
Palpate the bladder (over the symphysis pubis and abdomen) for distention. *The bladder is normally not palpable.*	■ A distended bladder may be palpated at any point from the symphysis pubis to the umbilicus and is felt as a firm, rounded organ. It indicates urinary retention.

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NCLEX-RN® Review

Animation
The Kidney

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Case Studies
Urinary Calculi
Urine Characteristics
MediaLink Applications
Renal Function
Urinary Diversions
Links to Resources

TEST YOURSELF NCLEX-RN® REVIEW

1 What part of the kidney processes the blood to make urine?
1. ureter
2. medulla
3. pyramids
4. nephrons

2 A client has been vomiting for 4 hours. What hormone is increased as a result?
1. thyroxine
2. renin
3. aldosterone
4. ADH

3 What diagnostic test can be used to determine GFR as well as glomerular damage?
1. routine urinalysis
2. renal scan
3. creatinine clearance
4. renal biopsy

4 What gland encircles the male urethra at the base of the bladder?
1. spleen
2. pancreas
3. prostate
4. adrenal

5 Your client tells you of having to get up to void several times a night. You record this finding as:
1. polyuria.
2. nocturia.
3. dysuria.
4. hematuria.

6 What question would you ask a client prior to an IVP?
1. "Are you allergic to shellfish?"
2. "Do you have burning on urination?"
3. "Have you ever had kidney stones?"
4. "Why are you having this test?"

7 Before beginning the physical assessment of the urinary system, you should ask the client to:
1. empty the bladder.
2. take several deep breaths.
3. provide a urine specimen.
4. drink several glasses of water.

8 Following surgery, your client has not voided for 12 hours. What assessment should you make?
1. Palpate for bladder distention.
2. Auscultate for bowel sounds.
3. Inspect for edema of the urethra.
4. Percuss for gastric tympany.

9 Of the following health problems an older woman may have, which is not normally a part of aging of the urinary system?
1. increased risk for hematuria
2. decreased risk for infection
3. urine that is darker in color
4. urinary incontinence

10 What assessment would you use to assess hydration status of a client?
1. auscultation of renal arteries
2. palpation for skin turgor
3. percussion for dullness over bladder
4. palpation of both kidneys

See Test Yourself answers in Appendix C.

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Perform abdominal assessment, or risk missing life-threatening trauma injury: Don't allow 'invisible' injuries to escape detection in your ED. (2004). *ED Nursing, 7*(7), 73–75.

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