CHAPTER 11
The Urinary System

The urinary system includes two kidneys, two ureters, the bladder, and the urethra. This body system interacts with other organs of excretion—the lungs, skin, and intestines—to maintain the homeostatic equilibrium necessary for maintenance of life. The primary functions of the urinary system are to do the following:

1. Excrete toxic substances and waste products of metabolism
2. Regulate water balance in the body
3. Help maintain acid–base balance (when the pH of the blood is maintained between 7.35 and 7.45) in body fluids
4. Aid in controlling concentration of salts and other necessary substances in the blood

The kidneys filter about 200 liters of fluid from the blood each day and excrete from it toxins, metabolic waste products, drugs, and excess ions (particles carrying an electrical charge), which become part of the urine. At the same time, reusable substances needed by the body, such as glucose, amino acids, vitamins, sodium, calcium, chloride, potassium, and phosphate ions, are returned to the bloodstream. The kidneys also regulate the volume and chemical composition of blood and regulate the balance between water and salts and between acids and bases. They produce an enzyme called renin, which assists in regulating blood pressure and kidney function, and also a hormone called erythropoietin, which stimulates red blood cell production in the bone marrow (Marieb & Hoehn, 2013).

STRUCTURE OF THE KIDNEYS

The kidneys are paired, bean-shaped organs situated behind the abdominal cavity and slightly below the diaphragm, but outside the peritoneum, the membrane enclosing the abdominal cavity. In the average adult, each kidney is about 5 inches long. The kidneys have enormous reserve capacity, and it is estimated we can lose about 60% of the 1 million nephrons in the kidneys before blood chemistry is significantly impaired. Humans are able to live successfully with only one functioning kidney. Fibrous and fatty tissues anchor the kidneys to surrounding structures. Each kidney has three distinct areas: the cortex, or outer area; the medulla, below the cortex, and the pelvis, continuous with the ureter, a tube connecting each kidney with the bladder.

Kidneys have a rich blood supply because the renal arteries deliver approximately one fourth of the total cardiac output to the kidneys every minute. Each renal artery comes from the abdominal aorta and subdivides into smaller arteries in the kidneys. Veins leaving the kidneys trace the arterial blood pathway in reverse and exit the kidneys as the renal veins, which empty into the inferior vena cava (see Fig. 11.1).

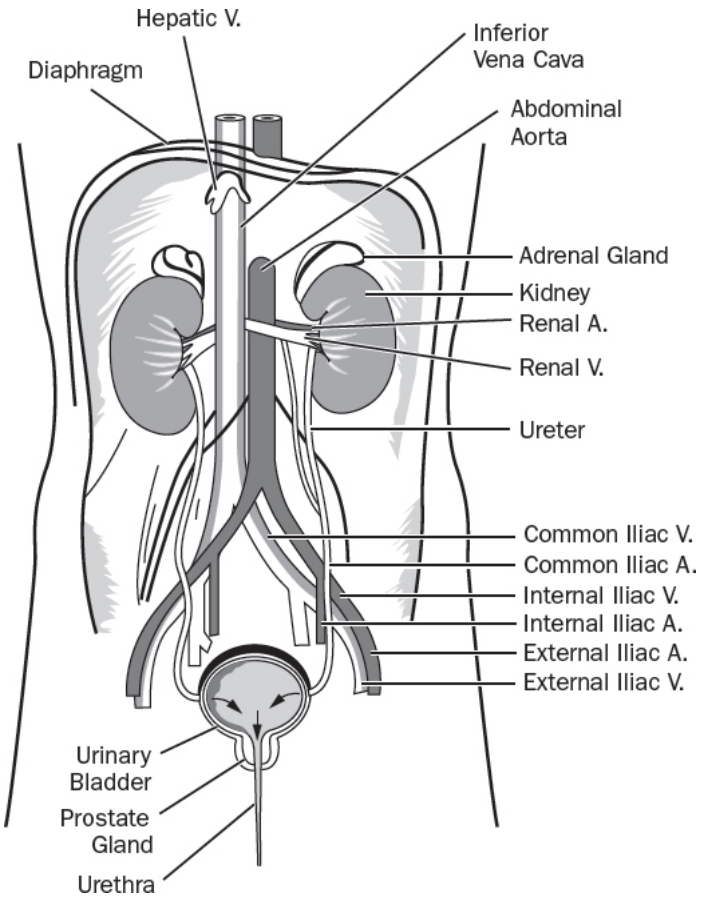

Figure 11.1. The urinary system, with blood vessels.

The basic unit of the kidney is the nephron, in which urine formation and other life-maintaining activities of the kidneys take place. Each kidney contains more than 1 million nephrons. A nephron consists of (a) a capsule enclosing a glomerulus (a coiled series of small blood capillaries), and (b) an attached renal tubule. Blood is carried from the renal artery to the capillaries of the glomerulus, an anatomical arrangement providing a rich blood supply to the nephron. Many substances (except blood cells and most plasma protein) pass freely from the blood entering the kidney into the glomerular capsule. Fluid filtering from the bloodstream into the capsule is called glomerular filtrate and is processed as it passes through the renal tubules. Some filtrate is converted to urine and reusable substances are sent back into the bloodstream. Material to be expelled from the body as urine passes successively through renal tubules, collecting tubules, renal pelvis, ureters, bladder, and urethra. Nephrons are located primarily in the cortical area of the kidney, whereas collecting tubules are primarily in the medulla of the kidney. As collecting tubules approach the renal pelvis, they fuse to form ducts that deliver urine to the ureter (see Fig. 11.2).

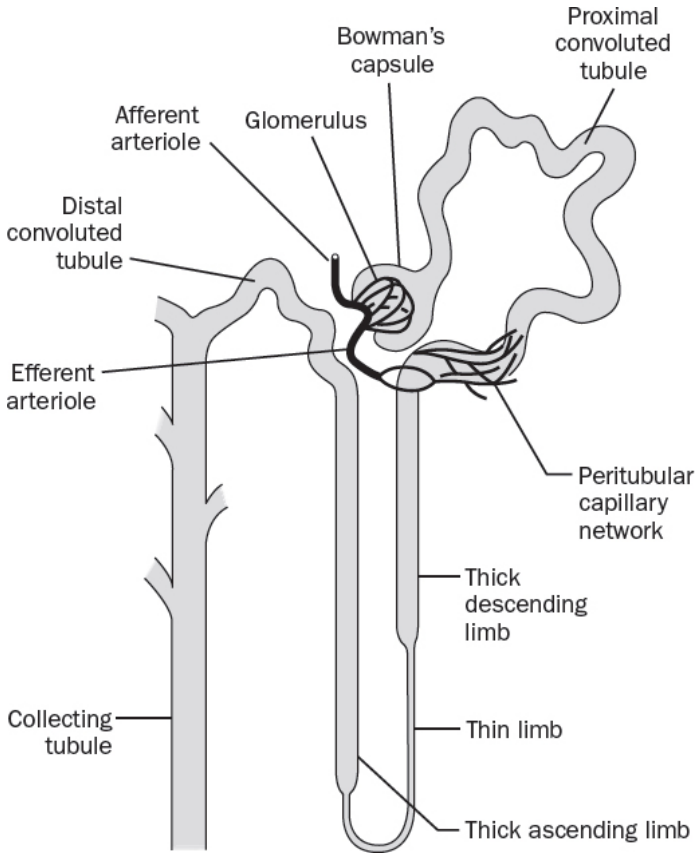

Figure 11.2. Diagram of the nephron, its blood supply, and attached collecting tubule.

FUNCTIONS OF THE URINARY SYSTEM

The kidneys process about 47 gallons of fluid daily. Of this, only about 1% leaves the body as urine; the rest is returned to the blood circulation to be reused, an amazing conservation mechanism in the body. Urine consists of about 95% water and 5% solids (organic and inorganic materials). The nephrons are totally responsible for urine formation. Urine formation and the adjustment of blood composition involve three processes: glomerular filtration, a function of the glomerulus; tubular reabsorption; and tubular secretion, both functions of the renal tubules.

Glomerular Filtration

The glomerulus is a highly efficient filter. As blood passes through the glomerulus, materials such as water, glucose, amino acids, and nitrogenous wastes pass easily from the glomerulus into the glomerular capsule and renal tubule, whereas other materials such as proteins and blood cells are usually not able to pass through the glomerular filtration membrane. Blood pressure provides the force for this filtration process. The amount of blood filtered by the glomeruli in a given time is the glomerular filtration rate (GFR).

Tubular Reabsorption

Urine is formed as the filtrate moves through renal tubules to the collecting ducts, the renal pelvis, and then into the ureters. Most of the contents of the renal tubules are passed through the tubule walls and returned to the bloodstream by way of blood capillaries surrounding the tubules. Material left in the tubules will become urine. This process is called tubular reabsorption. Creatinine is one substance not reabsorbed, making it useful in measuring GFR.

Tubular Secretion

Some selected substances are added to the filtrate through the tubular walls, or tubular reabsorption in reverse. Hydrogen and potassium ions, urea, creatinine, ammonia, and some organic acids enter the tubular fluid through the process of secretion. Urine is thus composed of both filtered and secreted substances.

System Dynamics

Renal clearance refers to the ability of the kidneys to clear (or cleanse) a given volume of plasma (fluid portion of the blood) of a particular substance in a given time, usually 1 minute. Renal clearance tests are used in the evaluation of GFR to determine glomerular dysfunction or damage.

Filtration, reabsorption, and tubular secretion constitute highly efficient processes for water conservation in the body. Concentration of urine is regulated according to the body's supply of water; for example, if there is excess water in the body, urine will be diluted because it will contain large quantities of excess fluid to be excreted. On the other hand, if body fluid level is low, the kidneys will concentrate urine, and more water will be reabsorbed (returned to body tissues). Water loss and retention in the kidneys are complex processes under both neural (nervous system) control and local control. When water concentration in the body is low, hypothalamic receptors stimulate the pituitary gland to produce an antidiuretic hormone. This hormone increases the reabsorption of water through tubule walls so more water is returned to body tissues for their use. Urine in the tubules, then, is more concentrated. Local control of water loss and retention depends on the amount of sodium in the glomerular filtrate. Certain cells near the glomerulus are stimulated by the sodium content of the filtrate to produce renin, an enzyme reducing the amount of water in the urine. Renin also stimulates secretion of an adrenal gland hormone called aldosterone. Aldosterone increases water loss from tubules by increasing the movement of sodium out of the tubular filtrate. Water is then drawn from urine to be made available for body use.

The analysis of urine (urinalysis) is a simple but valuable diagnostic tool that indicates disease by the presence of substances not normally found in urine, or by alterations in the proportions of substances normally present. When the kidneys stop functioning properly, three potentially dangerous situations occur.

1. The level of waste products in the blood increases.
2. Acidity of the blood increases because excess acid is no longer removed by the kidneys.
3. Sodium and water balance, crucial for life, is disrupted, producing serious disequilibrium of the internal environment.

Contractions of the smooth muscle walls of the ureters connecting the kidneys and the bladder force urine into the bladder. The bladder, where urine is collected and temporarily stored, is a muscular sac situated in the pelvic cavity. When approximately 300 milliliters (a little more than a cupful) of urine collects in the bladder, sensory receptors in the bladder walls are stimulated and the conscious desire to urinate results. As the bladder's sphincter muscles relax and open, urine is forced through the urethra and outside of the body (the act of urination or micturition). The urethra is short and exclusively excretory in females, whereas in males it extends from the bladder through the penis, carries both urine and semen, and thus has both excretory and reproductive functions.

Bladder function may be either voluntary or involuntary, depending on a variety of factors. For example, children must be taught bladder control, but this cannot be accomplished until the child is physically mature enough to be able to voluntarily withhold urine. Although normally controllable, in situations of extreme emotional stress or excitement, loss of voluntary bladder control (called stress incontinence) may occur, even in healthy adults. Urination is essentially a voluntary act, one of

tremendous significance in our culture, and any loss or decreased efficiency of bladder functioning (as sometimes happens in older age) is particularly embarrassing and psychologically difficult.

AGE-RELATED CHANGES IN THE URINARY SYSTEM

As with other body systems, the aging process results in gradual reduced efficiency of the urinary system. There may be greater sensitivity in older adults to admit to changes in the urinary system, and those who work with older adults must recognize this possibility when evaluating possible urinary difficulties.

Anatomical changes in the kidney associated with age include the following:

1. Kidney size decreases by age 80. This loss occurs primarily in the cortex of the kidney where the glomeruli are located. The overall number of glomeruli decreases 30% to 50% by age 70 (Aldwin & Gilmer, 2004). Functioning nephrons decrease both in number and size, although the kidneys generally continue to maintain homeostasis by regulating body fluid (Linton, 2007).
2. A steady increase in glomerular sclerosis (hardening of the glomeruli) occurs.
3. There is a decline in the number of cells of the renal tubules, an increase in tubular diverticula (outpouchings or pockets in walls), and a thickening of the tubular walls. These changes affect the kidney's ability to concentrate urine and reduce its ability to remove drugs from the body.
4. Blood vessels in the kidneys become smaller and thicker, and atherosclerotic changes occur that reduce blood flow through the kidneys and decrease GFR (Johnson, 2007).
5. The ureters, bladder, and urethra are all muscular structures and tend to lose tone and elasticity. The bladder especially may be affected as a decrease in muscle tone leads to incomplete emptying of the bladder, with a consequent greater risk of infections. Prostate enlargement in men can impair the emptying of the bladder and contribute to bladder contractions.
6. Some decline in bladder capacity often occurs, and less urine can be stored in the bladder. In addition, more urine is retained in the bladder after voiding (residual urine). Total bladder capacity declines from approximately 350 to 450 mL to about 200 to 300 mL in older age. Lessened reserve capacity, weaker muscle tone, and increased bladder contractions contribute to more frequent and also more urgent urination in many older persons, especially at night. In addition, the need or signal to urinate may be delayed until the bladder is almost full, resulting in even greater urgency and possibly incontinence (Miller, 2009).

Functional changes in the kidneys associated with the aging process include the following:

1. Blood flow decreases. Renal blood flow is reduced from approximately 600 mL/min to 300 mL/min between ages 40 and 80. Both a decrease in cardiac output and fewer blood vessels in the kidney contribute to decreased blood flow in the aging kidney.
2. Glomerular filtration rate declines. The glomerular filtration rate (GFR) as measured by serum creatinine levels is stable during young adulthood, but begins to decline after approximately age 40, although a decline is not universal. A decrease in GFR makes the removal of potentially toxic substances such as medications less efficient (Aldwin & Gilmer, 2004; Eliopoulos, 2014).

3. Ability to concentrate urine is decreased. With age, the kidney is not able to concentrate urine as well as it formerly did or dilute urine as needed. Older persons then are not as able to adapt as efficiently to dehydration or water overload. Crises may occur when water intake is reduced because of confusion, fear of incontinence, or any other reason, and especially if diuretics are being used.
4. Other functional changes identified in the older kidney indicate that maintaining the acid–base balance in the blood and regulating sodium and potassium levels may become more difficult (Tabloski, 2014).

AGE-RELATED DISORDERS OF THE URINARY SYSTEM

Medical problems involving the urinary system generally arise from the progressive decrease in renal function and renal blood supply with age, a greater likelihood of obstruction in the lower urinary tract, and increased susceptibility to urinary infections. Urinary tract and kidney disorders range from those easily treated to those that are life threatening, requiring long-term dialysis and organ replacement.

Urinary Tract Infections

An increased incidence of urinary tract infections (UTIs) occurs with age, especially after age 80. Women have about 80% of all UTIs, although the prevalence of UTIs in men increases significantly with age. Urinary tract infections affect more than 20 million people in the United States annually. Older adults, both women and men, have higher incidences of UTIs if institutionalized (Linton, 2007; Winkelman, 2013).

UTIs are commonly classified as uncomplicated or complicated. Uncomplicated UTIs occur in individuals who are essentially healthy and have normal voiding. They typically respond well to antibiotics and usually do not result in permanent damage. Complicated UTIs usually involve either functional or structural abnormalities in voiding, are difficult to treat, and readily result in permanent damage.

Urinary tract infections are caused by pathogenic microorganisms present in some part of the urinary tract with or without accompanying signs and symptoms. Sites of infection (and the names of their infections) include the bladder (cystitis) and the kidney (pyelonephritis). Women are more likely to develop UTIs because of the short female urethra and its proximity to the vagina, urethral glands, and rectum, leading to possible bacterial contamination (Winkelman, 2013).

Changes in bladder functioning associated with strokes or diabetes increase the risk of UTIs caused by incomplete emptying of the bladder, as do decreased estrogen levels in women, neurogenic bladder, and prostatic hyperplasia. Indwelling catheters also increase the risk of a UTI. Urinary tract infections are diagnosed by the presence of bacteria in the urine detected by urine culture and sensitivity tests. Renal ultrasonography may be used to determine structural problems. Treatment of UTIs involves judicious use of antibiotics, and men usually require longer periods of treatment than women (Tabloski, 2014).

Cystitis (Lower Urinary Tract Infection)

Cystitis is an inflammation of the bladder often found in older adults, especially women. It commonly results from urine flowing back into the bladder from the urethra, as a result of fecal contamination, or from a catheter or cystoscope. Typical symptoms include urgency and frequency of urination, voiding small amounts, burning or pain when urinating (dysuria), lower abdominal pain, nocturia (getting up at night to urinate), sometimes blood in the urine, and an overall sense of feeling unwell. A health care professional should be seen when symptoms are first noticed, because infections can spread to the

kidneys. However, in some older adults these typical symptoms may not be present. Diagnosis depends on the history of the symptoms, physical examination, urinalysis, and urine culture. Short-term antibiotic therapy is the preferred treatment, often with various over-the-counter (OTC) drugs to relieve symptoms, but recurring infections often require long-term, low-dose therapy. Liberal amounts of fluids are encouraged to cause voiding every 2 to 3 hours to flush bacteria from the urinary tract.

Pyelonephritis (Upper Urinary Tract Infection)

Pyelonephritis is an inflammation of one or both kidneys. Bacteria may enter the bladder via the urethra and ascend to the kidney, or they may enter the kidney through the bloodstream. Left untreated, pyelonephritis can lead to an accumulation of toxic materials in the blood, structural damage to the kidneys, uremia (retention in the blood of nitrogenous substances usually excreted by the kidneys), and progressive renal failure. Many older adults are asymptomatic, and pyelonephritis often goes undetected until it is at an advanced stage such as renal failure. If symptoms do occur, they include pain in the kidney area, tenderness in the back over the kidneys, chills and fever, nausea, vomiting, and a possible change in mental status. Chronic pyelonephritis symptoms include fatigue, weight loss, frequent urination, and anorexia. Diagnosis is by computed tomography (CT) scan, ultrasound, urine culture, blood cultures, and measurement of serum creatinine levels. Treatment is essentially the same as for cystitis, but the course of treatment is longer.

Acute Glomerulonephritis

Although once considered to be primarily a disease of the young, data now indicate glomerulonephritis is more prevalent in older adults than previously thought but may often be so subtly presented that it is not diagnosed (Linton, 2007). It is actually a group of kidney disorders characterized by an inflammatory response in the glomeruli resulting from immune system reactions; it is not an infection of the kidney per se. Symptoms include fatigue, anorexia (loss of appetite), hypertension, anemia, facial edema (swelling) preceding pharyngitis (inflammation of the pharynx), proteinuria (proteins in the urine), and oliguria (decreased amount of urine excreted). Diagnosis involves urinalysis, serum creatinine, and blood urea nitrogen (BUN) studies. Renal biopsy is usually considered to be the best diagnostic procedure. Treatment considerations are to protect kidney functioning and treat complications quickly. Bedrest is helpful during the acute phase. Antibiotics are used to eliminate causative factors, sodium and protein are restricted, and fluid intake and excretion are monitored. Control of high blood pressure with various hypertensive medications is an extremely important part of successful treatment. Chronic glomerulonephritis may occur if the acute phase lasts longer than 1 year, although actually it does not usually follow an acute phase. Most individuals with chronic glomerulonephritis progress to renal failure. Treatment with peritoneal or hemodialysis allows individuals to live for some years, but eventually, unless a kidney transplant is performed, death ensues.

Benign Prostatic Hyperplasia

Considered part of the male reproductive system, the prostate gland often interferes with urinary function in older males. Anatomically it is located near the base of the bladder and surrounds the urethra. Benign prostatic hyperplasia (BPH) is a nonmalignant prostate enlargement that often produces symptoms of urethral obstruction after age 50, affecting approximately 50% of men between ages of 51 and 60 and increasing to 90% of men older than age 80 (Tabloski, 2014). Its etiology is still somewhat unclear, but hormones and aging both play some role. As the prostate gland enlarges, it compresses the urethra, which leads to urinary obstruction and ultimately to urinary retention. Urinary obstruction results in incomplete emptying of the bladder, urinary stasis (stagnation of normal flow of urine), UTI, bladder stones, and bladder diverticula.

Although many middle-aged and older men have some BPH, not all experience symptoms. Early symptoms include straining to urinate, difficulty in starting the urinary stream, longer time necessary to urinate, and a feeling of incomplete bladder emptying. These symptoms are referred to as “lower urinary tract symptoms,” or LUTS. As prostate enlargement continues, urinary urgency and frequency occur, as does nocturia (getting up at night to urinate), which often contributes to sleep disorders (Lippert, Macchia, & Rothman, 2008; Tabloski, 2014).

Diagnosis usually includes a thorough history, physical examination of the prostate, neurological examination to rule out neurological problems, urinalysis, and a blood test for prostate-specific antigen (PSA) to exclude prostate cancer. Imaging studies such as transabdominal ultrasound and transrectal ultrasound (TRUS) are also used. Diagnosis is essentially one of exclusion after other possible diagnoses have been eliminated from consideration.

Treatment depends on how much the symptoms are a problem for the person. The International Prostate Symptom Score is a questionnaire ranking severity of symptoms on a numerical scale to indicate how bothersome symptoms are to the individual (Ignatavicius, 2013). Current treatment options are weight loss if needed, increased exercise, behavior modification, and various anticholinergic medications. If symptoms worsen, other medications are available. Minimally invasive surgical therapies (MIST) may be used for moderate to severe symptoms, and transurethral resection of the prostate (TURP) is often used in more severe situations (Tabloski, 2014). Some newer types of treatment modalities include laser therapy, stent therapy, and various types of thermotherapy.

Many men do not report symptoms until they are extreme and immediate intervention is necessary. Sometimes embarrassment is the primary reason, or fear about impotence if surgery is necessary. Health care professionals need to be sensitive to individual concerns about possible impotence, and this issue should be addressed before any surgical intervention.

Urolithiasis (Kidney Stone Disease)

Urolithiasis refers to the presence of stones (calculi) in the urinary tract, usually either in the kidney or ureter. Stones are formed by the deposition of crystalline substances excreted in urine, but the exact mechanism of stone formation is not clear. Three specific conditions are necessary for stone formation (Winkelman, 2013):

1. A slow flow of urine resulting in supersaturation of urine with some element (such as calcium) that crystallizes and later becomes a stone.
2. The lining of the urinary tract becomes damaged by irritation from crystals.
3. Insufficient amounts of substances in the urine that tend to inhibit and prevent supersaturation of urine and formation of crystals.

Factors involved in the incidence and type of stone formation include metabolic (at least 90% of those who form stones have a metabolic risk factor), dietary, genetic, geographic location, and family history. If stones block urine flow, a urinary infection usually occurs. Some stones cause very little pain, whereas others, especially those lodged in the ureter, result in excruciating pain. Spontaneous passage of stones occurs in approximately 80% of cases. However, stones too large to be passed through the system have to removed or broken up so they can pass through and be excreted.

Diagnosis involves medical history, including family history of urological stones, physical examination, urinalysis, and blood work. Stones can be visualized on radiographs and CT scans, and noncontrast CT is especially sensitive to identify stones. Renal ultrasonography is also useful to identify size and placement of stones. Treatment is directed toward pain control, removal of stones, preserving nephrons, and controlling infection. If pain is too severe, or if another infection is

present, or if stones block the urinary tract, medical or surgical treatment is warranted. Lithotripsy is a procedure used to break up stones in the kidney so they can be voided. Extracorporeal shock wave lithotripsy (ESWL) is a very common procedure for treating kidney stones. If obstruction occurs or the stone is too large to be excreted, various minimally invasive surgical procedures may be necessary. If they are not effective, major surgery may be performed. Although there are different types of stones, general prevention includes increasing fluid intake; modifying diet to increase fiber; eating more calcium-rich foods; eating less meat (beef, pork, poultry); avoiding foods high in oxalate such as nuts, chocolate, and dark green vegetables; restricting purines; and reducing salt intake. If dietary modification is not effective, certain medications may help dissolve stones or prevent other occurrences.

Cancer of the Bladder

Cancer of the bladder is more common in those older than 50 and affects men more than women. Risk factors for bladder cancer include cigarette smoking and prolonged exposure to carcinogens (such as dyes, rubber, leather, ink, paint) in the workplace. There also may be a causal relationship between bladder cancer and excessive use of analgesics. Cancers of the prostate, colon, and rectum in men and lower gynecological tract cancers in women commonly metastasize to the bladder. Symptoms include blood in the urine, painful or difficult urination (dysuria), urinary frequency or urgency, and lower back pain. Diagnosis involves cystoscopic examinations and biopsy, CT scan, and MRI. Other scans may also be deemed appropriate depending on the specific situation. Treatment options include surgery, chemotherapy, radiation, and immunotherapy (Eliopoulos, 2014). Metastases and recurrences of bladder cancer are common.

Urinary Incontinence

Urinary incontinence refers to the involuntary passing of urine in quantities that constitute a social or health problem (Linton, 2007). Institutionalized individuals experience more incontinence than those living in the community, but incontinence is often a major reason for institutionalization because of difficulty managing it in the home. Although not an inevitable part of the aging process, many older adults do experience varying degrees of incontinence, with women more often affected than men. It is estimated that approximately one in three older adults living the community have some urinary incontinence (Tabloski, 2014).

Age-related changes contributing to urinary incontinence in women may often be related to lessened estrogen levels, which cause a weakening of the pelvic floor and bladder outlet as well as a decrease in urethral muscle tone that contributes to vaginal inflammation. In men, age-related enlargement of the prostate gland can lead to decreased urinary flow, increased possibility of urine retention, and weakness of the detrusor muscle of the bladder, all contributing to urinary incontinence. Other possible causes of incontinence in both women and men include delirium, drugs, diuretics, infections, and diabetes.

Incontinence is usually classified as either transient or established. Transient incontinence develops suddenly (acute) and is related to an accompanying health (medical or surgical) condition, including medications as a possible cause. When the medical condition is resolved, incontinence is relieved. Established incontinence, however, is chronic and persists over time, becoming progressively worse (Eliopoulos, 2014). Several types of incontinence have been identified:

1. Stress incontinence, primarily caused by weakened muscles in the pelvic floor, is common in women who have had many children. Involuntary passage of urine occurs when intraabdominal pressure is increased such as in laughing, coughing, sneezing, or during exercise.

2. Urge incontinence, or an inability to delay voiding after the perception that the bladder is full, may be due to a urinary tract infection, prostate enlargement, bladder or pelvic tumors, or central nervous system (CNS) impairment after a stroke.
3. Reflex incontinence, a variation of urge incontinence, is the sudden leaking of large amounts of urine without a sensation of urgency or full bladder. It is caused by lesions in the cerebral cortex, multiple sclerosis, or other neurological disturbances.
4. Overflow incontinence is caused by prostate enlargement and obstruction, or by some medications, or nervous system disturbances affecting the bladder. Small amounts of urine leak from the distended bladder, frequently or even continuously.

Other types of incontinence reported in the literature are mixed incontinence, a combination of stress and urge incontinence; functional incontinence, or loss of urine because of inability or unwillingness to get to the toilet in time or because of cognitive impairment; and iatrogenic incontinence, primarily caused by medications (Eliopoulos, 2014; Linton, 2007). Nocturia, or frequency of urination at night, is often very disruptive for older adults, with potentially serious consequences for health because, aside from the danger of falling when getting up at night for a trip to the bathroom, sleep interruption may result in fatigue, forgetfulness, disorientation, depression, and sleep disorders.

Incontinence can be a devastating behavior problem for older adults, with enormous psychological and social implications. Control of both bowel and bladder functions is required and closely related to socialized behavior in our society; loss of these functions is viewed as personal incompetence and usually has a decidedly negative effect on self-esteem. Older adults often severely restrict their activities, social interactions, and interpersonal relationships because of concerns about incontinence. Many older adults will not admit to incontinence and therefore do not seek assistance in managing it. Others do not think incontinence can be treated because they believe it is part of growing old (Linton, 2007; Winkelman, 2013). Those who do seek aid may be virtually ignored by many health care professionals, who may also erroneously believe it is an inescapable part of the aging process and that effective intervention is not possible or necessary. Although there are age-related changes in the urinary tract that predispose older adults to varying degrees of urinary incontinence, it is not an inevitable occurrence in the normal aging process. Helpful treatment and management techniques are available and should be made easily accessible to older adults.

Urinary incontinence has many possible causes, and careful evaluation of the individual is necessary in order to plan individualized treatment. Assessment must include a thorough history of the problem, physical examination, relevant environmental and social factors, a functional assessment, consideration of associated medical conditions possibly influencing urinary patterns, previous surgeries, and current medications. The physical examination should assess mental status; mobility; dexterity; and neurological, abdominal, rectal, and pelvic status. Urodynamic tests such as ultrasound of the kidneys and bladder and a provoked full-bladder stress test can provide additional information. Specific tests useful in assessment are urinalysis, serum creatinine or BUN levels, measurement of postvoid residual urine volume, possibly urine culture, and measurement of blood glucose levels.

The selection of an intervention depends on the cause of the incontinence and the individual’s personality and motivation. Treatment options include (a) timed voiding and bladder training; (b) Kegel, or pelvic floor, exercises; (c) judicious use of medicines; and (d) incontinence pads if absolutely necessary and used as a last resort.

Other techniques that may be useful include the following:

(a) *Biofeedback*. Use of visual or auditory instruments to provide moment-to-moment information on how effectively an individual is controlling muscles associated with urination. With practice, many people can learn to control the relevant muscles.

(b) *Urinary control methods*. Newer devices for controlling the flow of urine include a small balloon that rests at the neck of the bladder and can be inflated or deflated to control urination; urethral plugs and intraurethral catheters with valves to control the flow of urine in women; and an external device that provides a watertight seal to prevent leakage. Such devices are constantly being developed for both women and men with varying degrees of success, but they offer other possible options for incontinence control (Miller, 2009; Newman, 2007). Minimally invasive surgical procedures are also available for both women and men to treat incontinence.

(c) *Catheters*. In some situations catheters are used to control and manage incontinence, but other treatment options should be evaluated and tried first. If other forms of treatment are deemed not appropriate and do not help, catheters may be a remaining option. Clean intermittent catheterization or indwelling catheters may be used, but both must be used carefully with older adults.

In actuality, most cases of urinary incontinence can be cured or improved, and every individual with urinary incontinence is entitled to proper evaluation and appropriate treatment. As indicated previously, too often older adults, family, and health care professionals do not seek appropriate interventions for incontinence. A persistent, prevalent myth is that incontinence is normal and inevitable in older age, a most inappropriate point of view leading to unnecessary embarrassment and discomfort. One further concern is that fluid intake should never be restricted in an effort to reduce incontinence episodes in older adults because it can quickly cause dangerous dehydration. Fluids can be taken earlier in the day to minimize getting up at night to urinate, but adequate fluid intake must be maintained in this age group.

Renal Failure

When the kidneys are unable to perform their regulatory functions or remove metabolic waste products from the body, renal failure results. Substances normally excreted in urine accumulate in body fluids, disrupt endocrine and metabolic functions, and cause serious disturbances of fluid, electrolyte, and acid–base levels.

In acute renal failure (sometimes identified as acute kidney injury) there is a sudden loss of kidney function caused by failure of renal circulation or glomerular or tubular dysfunction. Some leading causes of acute renal failure are a sudden decrease in blood flow to kidneys; damage from certain medications, poisons, or infection; and sudden blockage that prevents urine from leaving the kidneys. Specifically, chronic diseases such as hypertension and diabetes can cause renal failure, as can prostatic hypertrophy. In older adults, renal failure may reflect lessened reserve capacity for maintaining homeostasis (a) when there has been a loss of body fluids and electrolytes because of diarrhea or vomiting, (b) in situations involving inadequate intake of fluids, (c) when infections are present, or (d) after stress induced by surgery or a heart attack. Symptoms of acute renal failure are lethargy, feeling restless, nausea, vomiting, diarrhea, dry skin and mucous membranes, headache, pain in the back (flank pain), and low urinary output. Diagnosis is based on urinalysis, urine chemistry examinations, radiography, and renal ultrasonography. CT and MRI scans may be useful as well. Treatment involves correcting any reversible cause, restoring fluid levels, correcting biochemical imbalances, and maintaining good nutrition (LaCharity, 2013).

Chronic renal failure (CRF) is progressive deterioration of renal function resulting in uremia (an excess of urea and other nitrogenous waste products in the blood). Stages of chronic renal failure are decreased renal reserve leading to renal insufficiency, which then progresses to renal failure and, finally, to uremia. Death will occur unless dialysis or a kidney

transplant is performed. Diabetes, prostatic hyperplasia, hypertension, and longterm use of nonsteroidal anti-inflammatory drugs (NSAIDs) can contribute to chronic renal failure (Tabloski, 2014). Symptoms include fatigue and lethargy, headache, general weakness, and gastrointestinal disturbances. However, symptoms may go unnoticed until the disease is in advanced stages. If untreated, symptoms increase in severity, followed by deep coma, often accompanied by convulsions, and finally death.

Diagnosis involves evaluation of the following: anemia, elevated serum creatinine or BUN, elevated serum phosphorus, decreased serum calcium, low serum proteins, and usually low carbon dioxide and acidosis (low blood pH). Treatment is concerned with maintaining homeostasis and kidney function for as long as possible. Attention to diet is important, especially protein intake, fluid intake, sodium intake, adequate calories, and vitamins. Specific symptoms are treated when they occur to improve renal function. When conservative management techniques fail, maintenance dialysis or kidney transplantation are the remaining treatment choices (Tabloski, 2014). One note of caution is that symptoms of renal disease in older adults are often nonspecific, and other disorders present may mask symptoms of renal disease.

SUMMARY

The urinary system becomes less efficient with age, but barring accident, disease, or unusually high demand situations, it will function adequately into extreme old age. Exercise, proper diet—including adequate fluid intake, limited use of medications, and not smoking—help the urinary system maintain adequate functioning.

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