Urinary-Renal System

PHYSIOLOGY OF THE KIDNEY AND URINARY TRACT

A. Kidney function.
   1. Excretory.
      a. Rid the body of metabolic wastes.
         (1) Regulate fluid volume; normally, 125 mL of fluid is filtered each minute (glomerular filtration rate [GFR]); however, only 1 mL is excreted as urine; average urine output is about 1440 mL per day.
         (2) Regulate the composition of electrolytes.
         (3) Assist in maintaining acid-base balance.
      b. Regulation of blood pressure.
         (1) Juxtaglomerular cells are located in the afferent arteriole just before it enters the glomerulus.
         (2) The cells respond to a decrease in the blood flow (decrease in blood pressure) by increasing the secretion of renin.
         (3) Renin acts on angiotensin I and converts it to angiotensin II, which is a powerful vasoconstrictor. Peripheral resistance is increased; therefore, blood pressure is increased.
         (4) Kidneys receive 20% to 25% of total cardiac output with a renal blood flow rate of 600 to 1300 mL/min.
   2. Endocrine.
      a. Aldosterone production is stimulated by the increase in angiotensin I; therefore sodium and water are retained to increase circulating volume and increase blood pressure.
      b. Regulates red blood cell production through synthesis of erythropoietin; released in response to hypoxia and reduced renal blood flow.
      c. Aids in calcium metabolism by activating vitamin D, which allows for absorption of calcium from the gastrointestinal tract.

B. Nephron function.
   1. Filtration: occurs in the glomerulus via a semipermeable membrane. The membrane does not normally allow large protein molecules to be filtered out of the blood.
      a. GFR is the amount of blood filtered by the glomeruli in a given time (approximately 120 to 140 mL/min).
   2. Tubular reabsorption: after the glomerulus has filtered the blood, the tubules separate the water and solutes by osmosis and diffusion. Water moves across the semipermeable membrane and is reabsorbed or excreted in response to the concentration gradient of the solutes (sodium, potassium, chloride, urea, etc.). Only a small amount of the total water filtered out of the kidneys is excreted as urine. Solutes are also reabsorbed according to the concentration gradient.

b. Changes in GFR occur when the pressure gradients from the glomerular capillaries across the semipermeable membrane to the glomerulus are altered.
   (1) Pressure gradient changes occur when there is a variation in the systemic blood pressure (hypotension), a significant change in the pressure in Bowman's capsule in the glomerulus (edema) occurs, and when ureteral obstruction occurs.
   (2) The kidneys' response to changes in pressures is buffered by an autoregulatory mechanism to maintain a stable range of blood pressure. The autoregulatory mechanism maintains renal blood flow and the GFR within wide fluctuations of blood pressure. When the pressure range is outside the autoregulatory mechanism (hypotension/hypertension), the GFR will fluctuate with the systemic blood pressure.

NURSING PRIORITY Determine whether client has a decreased urinary output (below 30 mL per hour in an adult, 20 mL per hour in a child, and 1 mL/kg/hr in an infant); urinary output should be carefully evaluated regarding blood pressure level; blood pressure must provide renal perfusion to maintain adequate urinary output. The level of blood pressure to maintain renal perfusion varies greatly from one client to another.

(3) If the glomerular membrane is damaged, plasma proteins will escape. A decrease in serum proteins decreases the normal serum oncotic pressure; this results in water retention and edema formation.

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3. Tubular secretion: regulates the potassium level and maintains the acid-base balance with other regulatory mechanisms.

C. Urinary tract.
1. Ureters.
   a. Muscular tubes through which urine flows from the kidneys to the bladder.
   b. Ureterovesical valve: located at the opening of the ureter into the bladder (ureterovesical junction); prevents backflow of urine into the ureters when the bladder contracts.

2. Bladder.
   a. As the bladder fills, the stretch receptors are stimulated. In the adult, the first urge to void will occur when 100 mL to 150 mL has collected; approximately 400 mL to 600 mL of urine will initiate a feeling of bladder fullness.
   b. Bladder capacity varies from 600 mL to 1000 mL.
3. Voiding: stimulation is sent to the sacral area of the spinal column where the micturition reflex, or voiding reflex, is initiated; after toilet training, the cerebral cortex (via the spinal column) allows for voluntary control of bladder contractions that initiate urination.
4. Urethra: a small, membranous tube that conveys urine from the bladder to the exterior of the body.
   a. Female urethra is 1 to 2 inches long.
   b. Male urethra is 8 to 10 inches.

System Assessment

A. External assessment.
1. Inspect skin for changes in color, turgor, texture (urate crystals), bruising, and excoriations.
2. Assess face, abdomen, and extremities for edema.
3. Determine weight gain or loss.
4. Palpate kidneys and bladder.
   a. Landmark: for kidney palpation, the landmark is the costovertebral angle, formed by the rib cage and the vertebral column.
   b. Bladder is palpated just above the suprapubic area (or symphysis pubis bone).
   c. Kidney and bladder should be nonpalpable with no discomfort on palpation.
5. General: fatigue, lethargy, level of alertness.

B. History.
1. Presence of renal or urologic congenital defect.
2. Determine whether client has ever been exposed to chemicals, especially carbon tetrachloride, phenol, and ethylene glycol, because these are nephrotoxic.
3. Determine whether client has received antibiotics that may be nephrotoxic: aminoglycosides, amphotericin B, and sulfonamides.
4. Assess dietary intake: determine increased levels of calcium. Anorexia and nausea and vomiting may cause dehydration or be the result of altered renal function.
5. Determine level of activity: immobility leads to demineralization of the bones, which can predispose to infection and calculus formation.
6. Evaluate complaints of pain: dysuria; flank, costovertebral, or suprapubic pain.
7. Assess changes in pattern of urination: frequency, nocturia, urgency, enuresis, incontinence (Box 23-1 and Table 23-1).
8. Assess changes in urine output: polyuria, oliguria, anuria.
9. Assess changes in urine consistency: hematuria, pyuria, diluted, concentrated, change in color.
10. Determine whether client is taking any medications that may affect urinary or renal function.
11. Determine whether client has any chronic health care problems that affect renal and urinary tract structures (diabetes mellitus, hypertension, allergies, or multiple sclerosis).

DISORDERS OF THE URINARY-RENAL SYSTEM

Urinary Tract Infections

Stasis of urine in the bladder and reflux of urine back into the original reservoir are the primary causes of urinary tract infections (UTIs). Escherichia coli is the most common pathogen leading to UTIs (Figure 23-1).

A. Upper UTI: pyelonephritis, an inflammation of the renal pelvis and the parenchyma of the kidney(s).

B. Lower UTI.
1. Cystitis: inflammation/infection of the bladder.
2. Urethritis: inflammation of the urethra.

Box 23-1 OLDER ADULT CARE FOCUS

Dealing with Incontinence

Need to Determine:
- Does client have difficulty initiating urinary flow?
- Is client aware of need to void?
- Can client empty bladder completely, or is there residual urine?
- Is there bladder distention and overflow dribbling?
- Is stress incontinence present or urge incontinence?
- What are usual voiding times?
- Is the client constipated or is there an impaction? Is this a chronic problem?

Nursing Interventions
- Help the client determine when he or she needs to urinate before an accident occurs.
- Maintain adequate fluid intake but limit fluids before bedtime.
- Establish a voiding schedule; offer assistance and encourage voiding.
- Assess the client’s access to the bathroom; determine need for a bedside commode.
- Assess for presence of urinary tract infection.
- Teach client how to perform Kegel exercises.
TABLE 23-1  

<table>
<thead>
<tr>
<th>Type of UI</th>
<th>Definition</th>
<th>Pathophysiology</th>
<th>Symptoms and Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urge</td>
<td>Involuntary loss of urine associated with a strong sensation of urgency</td>
<td>• Involuntary detrusor (bladder) contractions (DI), along with sphincter relaxation</td>
<td>Loss of urine with an abrupt and strong desire to void; involuntary loss of urine (without symptoms); nocturia is common</td>
</tr>
<tr>
<td>Stress</td>
<td>Urethral sphincter failure, usually associated with increased intraabdominal pressure</td>
<td>• Urethral hypermobility caused by anatomic changes or defects such as fascial detachments, relaxed pelvic floor musculature, atrophy due to loss of estrogen; ISD: Failure of the sphincter at rest (prostate surgery for BPH or cancer)</td>
<td>Small amount of urine loss during coughing, sneezing, laughing, or other physical activities; continuous leak at rest or with minimal exertion (e.g., postural changes)</td>
</tr>
<tr>
<td>Mixed</td>
<td>Combination of urge and stress UI</td>
<td>• Combination of urge and stress features (as listed above)</td>
<td>Combinations of urge and stress UI symptoms (as listed above)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Common in women, particularly postmenopausal women</td>
<td></td>
</tr>
<tr>
<td>Overflow</td>
<td>Bladder overdistention</td>
<td>• A contractile detrusor</td>
<td>Frequent or constant dribbling or urge or stress incontinence symptoms, as well as urgency and frequent urination</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hypotonic or underactive detrusor caused by drugs, fecal impaction, diabetes, lower spinal cord injury, or disruption of the motor innervation of the detrusor muscle</td>
<td>Residual urine after voiding is common</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• In men—secondary obstruction caused by prostatic hyperplasia, prostatic carcinoma, or urethral stricture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• In women—obstruction caused by severe genital prolapse or surgical overcorrection of urethral detachment</td>
<td></td>
</tr>
<tr>
<td>Functional</td>
<td>Chronic impairment of physical and/or cognitive functioning</td>
<td>• Chronic functional and mental disabilities</td>
<td>Urge incontinence or functional limitations or environmental factors</td>
</tr>
<tr>
<td>Unconscious or reflex</td>
<td>Neurologic dysfunction secondary to nerve damage</td>
<td>• Decreased bladder compliance with risk for vesicoureteral reflux and hydronephrosis</td>
<td>Postmicturitional or continual incontinence; severe urgency with bladder hypersensitivity (sensory urgency)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Caused by radiation cystitis, inflammatory bladder conditions, radical pelvic surgery, or spinal cord lesions above S2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• In many non-neurogenic cases, no demonstrable DI</td>
<td></td>
</tr>
</tbody>
</table>


DHIC, Detrusor hyperactivity with impaired bladder contractility; DI, detrusor instability; ISD, intrinsic urethral sphincter deficiency; UI, urinary incontinence.

C. UTIs occur in an ascending route up the urinary tract system.

**ALERT** Use alternative measures to promote voiding; promote bowel and bladder control.

**Assessment**

A. Factors contributing to UTI.

1. Adult female urethra is short and close to the rectum and vagina, which predisposes it to contamination from fecal material.
2. Vesicoureteral reflux (ureterovesical reflux): the reflux of urine from the bladder into one or both of the ureters and possibly into the renal pelvis.
3. Obstruction of urinary flow: congenital anomalies, urethral strictures, ureteral stones, contracture of the bladder neck, tumor, fibrosis, or fecal impaction (Figure 23-2).
4. Instrumentation: catheterization or cystoscopic examination.
5. Stasis of urine in the bladder leading to urinary retention for any reason (clients with prostate disease).
6. Bladder hypothenia: mechanical compression of the ureters; hormone changes predispose pregnant and postmenopausal women to more frequent UTIs.
7. Diabetes, spinal cord injury, or neurogenic bladder.
8. Metabolic disorders such as diabetes.
9. Sexual intercourse promotes development of UTI.
10. Fecal contamination of the urethral meatus.

**ALERT** Identify an infection and be able to assess and to identify pertinent data indicating a urinary tract and/or kidney infection.

B. Clinical manifestations.
1. Cystitis (lower UTI).
   a. Frequency, urgency, dysuria (classic triad of symptoms).
   b. Hematuria.

c. Nocturia, incontinence, hesitancy, weak stream.
d. Often asymptomatic with bacteriuria.
e. Low back pain or suprapubic pain.

2. Pyelonephritis (upper UTI).
   a. Fever, chills, malaise, flank pain on affected side.
   b. Symptoms of cystitis.
   c. Older adults may not have a fever, and those older than 80 years may have a decrease in temperature and exhibit confusion (Box 23-2).

3. Urosepsis: a urinary tract infection that has become systemic and is life threatening.

C. Diagnostics (see Appendix 23-1).

D. Complications.
1. A lower UTI may progress to an upper UTI.
2. Chronic pyelonephritis may develop after repeated bouts of acute pyelonephritis.

**Treatment**
A. Medical (see Appendix 23-2).
1. Broad-spectrum antibiotics, especially the sulfonamides for lower urinary tract infections; fluoroquinolones for upper urinary tract infections.

2. Urinary analgesics.
3. Antispasmodics.
4. Antipyretics.

B. Dietary.
1. Encourage fluid intake of 3000 mL per day.
   a. Dilute urine causes less irritation.
   b. The increase in flow of urine through the urinary tract decreases the movement of bacteria up the urinary tract.
   c. Discourage consumption of carbonated beverages and foods or drinks containing baking powder or baking soda. Caffeine, alcohol, citrus fruits, and highly spiced foods can cause bladder irritation.
   d. Daily intake of cranberry juice or cranberry essence tablets is helpful for some clients, as it appears to decrease the ability of bacteria to adhere to the epithelial cells lining the urinary tract.
Nursing Interventions

Goal: To provide relief of pain, urgency, dysuria, and fever.
A. Antibiotics need to be taken as scheduled. Initially, therapy may be required for 1 to 3 days; if problem is recurrent, 10 to 14 days of therapy may be required. For pyelonephritis, antibiotics may be taken for 14 to 21 days; severe symptoms may require hospitalization.
B. Encourage consumption of 8 to 10 glasses of fluids daily (3000 mL).
C. Teach client importance of voiding every 2 to 3 hours during the day to completely empty the bladder.
D. Sitz baths may be taken to decrease irritation of urethra.

Goal: To prevent recurrence of infection.
A. Avoid sitting in a bathtub with added bubble bath products or other bath oils and fragrances; a warm bath will decrease symptoms, but nothing should be added to the water.
B. Explain importance of cleansing the perineal area from front to back after voiding and after each bowel movement. Avoid use of perineal sprays and powders.
C. If intercourse seems to predispose to infection, encourage voiding immediately before and after intercourse. A female client with recurrent UTIs may need to temporarily stop using a diaphragm and spermicidal creams/jelly.
D. Teach importance of long-term therapy if recurrent infections are a problem.
E. Encourage and explain the need for follow-up care to prevent complications of chronic UTIs.
F. Caffeine, alcohol, citrus juices, and carbonated beverages should be avoided.

Urinary Calculi

Stones may form anywhere in the urinary tract; the most common location for stones is in the pelvis of the kidney. If the stones are small, they may be passed into the bladder (see Figure 23–2).
A. Stones in the bladder may increase in size if urinary stasis and alkaline pH are present.
B. Types of urinary calculi.
   1. Calcium oxalate or phosphate stones: tend to be small; account for 40% to 50% of all upper urinary tract calculi.
   2. Struvite stones: contain bacteria and tend to be large; more common in women than men.
   3. Uric acid stones: occur most often in clients with primary or secondary problems of uric acid metabolism (gout); high incidence in men, particularly Jewish men.

Assessment

Regardless of the type of stone formed, the clinical manifestations, diagnostics, and treatment are essentially the same.

A. Risk factors/etiologies.
   1. Infection, urinary stasis, immobility.
   2. Hypercalcemia and hypercalciuria (hyperparathyroidism, renal tubular acidosis).
   3. Excessive intake of dietary proteins, which increases uric acid production.
   4. Excessive consumption of tea or fruit juice, which elevates urinary oxalate levels.
   5. Low fluid intake.
   6. Majority of clients are between the ages of 20 and 55. Stones occur more often in the summer months.
   7. Increased incidence of family history with stone formation due to inherited metabolic risk factors.

B. Clinical manifestations.
   1. Sharp, sudden, severe abdominal or flank pain.
      a. May be described as “colic,” either ureteral or renal.
      b. Pain may be intermittent, depending on the movement of the stone; spasm in the ureter occurs as it attempts to move the stone toward the bladder.
      c. Pain may radiate around the flank area, down into the bladder, the genitalia, and the thigh.
   2. Hematuria may be present as a result of the traumatic effects of the stone on the ureter and the bladder.
   3. Oliguria or anuria suggest urinary obstruction and must be treated immediately.
   4. Nausea and vomiting are common.
   5. May be associated with fever and infection.

C. Diagnostics (see Appendix 23–1).

D. Complications.
   1. Recurrent stone formation.
   2. Infection.
   3. Renal failure.

Treatment

A. Medical.
   1. Increase fluid intake to 3000 mL/day to decrease urine concentration.
   2. Medications that prevent the absorption of calcium (thiazide diuretics and phosphates).
   3. Spasmolytic agents (anticholinergics).
   4. For uric acid stones, allopurinol (Zyloprim).
   5. Opioids for pain relief.
   6. Dietary.
      a. Sodium may also be restricted, because sodium increases the excretion of calcium in the urine.
      b. Decrease in protein intake or an alkaline-ash diet for clients with uric acid stones.
      c. Decrease intake of cola, coffee, and tea, which tends to increase the risk for calculi formation.

B. Surgical.
   2. Ureterolithotomy: incision into the ureter to locate a stone and remove it.
3. Stenting: insertion of a small tube (stent) into ureter via ureteroscopy to dilate ureter to enlarge passageway for expulsion of stone or stone fragments.
C. Lithotripsy: cystoscopic, percutaneous ultrasonic, laser, or extracorporeal shock-wave lithotripsy (ESWL).
1. For ESWL, client is anesthetized and placed in a water bath. Some lithotripters do not require submersion.
   a. Sound waves travel through the water and are directed to the stone. The force of the sound wave shatters the stone, and the remains are excreted in the urine.
   b. It is essential that the client remain absolutely motionless during the procedure, which lasts about 30 to 45 minutes. Therefore some form of sedation or analgesia is necessary during the procedure.
   c. A ureteral stent is often placed after lithotripsy procedures to promote passage of stone fragments and left in place for 2 weeks.
2. Hematuria is common after the procedure.

Nursing Interventions
Goal: To relieve pain.
A. Administer analgesics as prescribed: morphine or hydro-morphine (Dilaudid).
B. Hot baths or moist heat applied to flank area.
C. Encourage increased fluid intake (3000 mL/day) to prevent dehydration.
D. Strain all urine and inspect for blood clots and passage of stone.
E. If stone is passed, it should be saved and sent to the lab for analysis to determine the type of stone so appropriate therapy can be maintained.

Goal: To promote understanding of health care regimen.
A. Dietary restrictions, depending on type of stone.
B. Discuss rationale, dose, frequency, and important information relating to medication administration.
C. Teach symptoms of recurring stone formation, such as hematuria, flank pain, and signs of infection.
D. Instruct client to continue high fluid intake.
E. Promote periodic medical follow-up visits to evaluate for symptoms of infection and recurring stone formation.

Hypospadias and Epispadias
A. Hypospadias: the urethral opening is located behind the glans penis or along the penile shaft; this is a common anomaly.
B. Epispadias: the urethral opening is located on the dorsal or upper side of the penis; this is a rare problem.

Assessment
A. Clinical manifestations.
   1. Visualization of defect.
   2. Chordee: ventral curvature of the penis, which gives it a crooked appearance (hypospadias).
   3. Stream of urine does not come out at the end of the penis.
4. Hypospadias is associated with cryptorchidism in severe cases.
5. Bladder exstrophy is a severe form of epispadias.

Treatment
A. Surgical correction of the defect.
   1. Hypospadias: recommended repair by 6 to 18 months of age.
   2. Epispadias is much more complex and frequently associated with other genitourinary system defects; repair may be very involved and require multiple staged surgical procedures.

Nursing Interventions

Goal: To provide emotional support and to promote normal growth and development.
A. Frequently the infant is not circumcised until the repair of the hypospadias.
B. The infant with epispadias may be discharged home before repair is done.
C. The preferred time for repair is between 6 and 12 months; it is important not to delay repair of hypospadias beyond the time for toilet training.
D. A diaper and a sterile nonadherent dressing are applied over the exposed bladder when the infant has a bladder defect.
E. Teach parents signs of UTI.
F. Help parents understand realistic expectations of the outcome of surgery (epispadias and/or bladder exstrophy).

Nephrotic Syndrome
A problem with glomerular permeability to plasma proteins results in massive urinary protein loss. The most common type is a primary condition, minimal change nephrotic syndrome.
A. Changes occur in the basement membrane of the glomeruli that allow the large protein molecules to pass through the membrane and be excreted. The loss of albumin from the serum decreases the oncotic pressure in the capillary bed and allows fluid to pass into the interstitial tissues and the abdominal cavity (ascites) and interstitial spaces (edema).
B. The interstitial fluid shift causes hypovolemia. The renin-angiotensin response is stimulated. Aldosterone secretion is increased, and the tubules begin to conserve sodium and water to increase the circulating volume.
C. In the majority of children with the syndrome, the cause is unknown; it may be congenital, idiopathic, or secondary to another disease; frequently, there is no evidence of renal dysfunction or systemic disease.

Assessment
A. Risk factors/etiology.
   1. Usual history is a well child who begins to gain weight and exhibits pallor and fatigue.
   2. Majority of children affected are male and between the ages of 2 and 4 years; uncommon in infants younger than 1 year.
3. May occur in adults secondary to systemic disease (e.g., SLE, diabetes) or may be idiopathic.

B. Clinical manifestations.
   a. Facial edema, especially periorbital edema; may be more pronounced in the morning and subside during the day.
   b. Generalized edema of the lower extremities; may increase during the day.
   c. Labia or scrotum may become very edematous.
   d. Edema may progress to the level of severe generalized edema (anasarca).
   e. Ascites and pleural effusion.
2. Gradual increase in weight.
3. Volume of urine is decreased, and urine may be foamy and tea colored.
4. Irritability, fatigue, lethargy.
5. Malnourishment: child is malnourished as a result of decreased intake and loss of protein in the urine but may not appear so because of edema.
6. Infection can result in significant morbidity or mortality.

C. Diagnostics (see Appendix 23–1).
1. Decreased serum protein levels: hypoalbuminemia.
2. Urinalysis: increased specific gravity, massive proteinuria (>3+ as determined by dipstick test).
3. Creatinine clearance may be decreased, with normal serum creatinine levels.

D. Potential complications.
1. Compromised immune system leading to an increase in infections (e.g., pneumonia, bronchitis, peritonitis).
2. Circulatory insufficiency caused by hypovolemia, with severe edema.
3. Thromboembolism secondary to hypercoagulability.

Treatment
A. Medical.
   2. Diuretics: used when edema progresses despite sodium restriction.
   3. Salt-poor human albumin is used for treatment of vascular insufficiency and severe edema.
   4. Prophylactic broad-spectrum antimicrobial agents.
   5. Immunosuppressant therapy is prescribed for children who are not responsive to steroid therapy.

B. Dietary.
   1. Decreased sodium intake.
   2. Proteins consumed should have high biologic value (low to moderate protein diet).
   3. Usually, fluid is not restricted.

Nursing Interventions
Goal: To monitor disease progress and reduce edema.
A. Support edematous areas such as scrotum.
B. Provide and encourage a salt-restricted diet.
C. Administer salt-poor albumin; monitor closely for circulatory overload during and after administration.

D. Provide meticulous skin care and keep opposing skin surfaces dry; change position frequently, and monitor good body alignment.

E. Determine weight daily, maintain accurate intake and output record, measure abdominal girth daily.

F. Test urine with dipstick for protein; check specific gravity.

G. Monitor cardiac function for complications of fluid balance (marked edema but hypovolemic).

Goal: To prevent infection.
A. Child is susceptible to infection because of a compromised immune state, as well as steroid therapy.
B. Protect child from upper respiratory tract infections; provide good pulmonary hygiene; check breath sounds.
C. Prevent skin excoriation and breakdown; assess carefully for indications of infection.

Goal: To promote nutrition.
A. Encourage low to moderate protein intake of high biologic value.
B. Serve frequent small quantities of food to child.
C. Encourage input from child in selection of foods from prescribed diet.

Home Care
A. Inform child and parents about medical regimen: steroids, diuretics, antibiotics.
B. Reassure parents that the prognosis is good; there may be relapses that will require therapy, but few children progress to chronic disease.
C. Obtain medical assistance if relapse occurs; relapse is indicated by edema, proteinuria, fever.
D. Encourage normal growth and development activities; try to prevent social isolation.
E. Teach parents how to perform dipstick urine test for protein; may need to keep a daily diary to evaluate level of proteinuria.

Glomerulonephritis
Glomerulonephritis is an inflammatory reaction in the glomerulus most commonly as a result of an antigen-antibody response to beta-hemolytic streptococci. An immune complex is formed as a result of the antigen-antibody formation; the complex becomes trapped in the glomerulus. As a result of the edema in the glomeruli, the GFR is significantly decreased. It is the third leading cause of renal failure in the United States.

Assessment
A. Risk factors/etiology.
   1. The stimulus of the antigen-antibody reaction is most often group A beta-hemolytic Streptococcus infection of the throat (tonsillitis, pharyngitis) or skin (impetigo), which ordinarily precedes the onset of the condition by about 10 to 21 days.
   2. Most common in children, but all age groups can be affected; males are more frequently affected than females.
B. Clinical manifestations (Figure 23-3).
   1. Acute glomerulonephritis.
      a. Disease may be mild with proteinuria and/or asymptomatic hematuria.
      b. Tea- or cola-colored urine caused by hematuria.
      c. Facial and periorbital edema.
      d. Decrease in urine output (oliguria).
      e. Mild to moderate increase in blood pressure; hypertension is more severe in adults.
      f. Azotemia: presence of nitrogenous waste products in the blood.
   2. Chronic glomerulonephritis: symptoms reflect progressive renal failure; more common in adults.
C. Diagnostics (see Appendix 23-1): reduced complement (C3) levels in early stages and elevated antistreptolysin O titer.

D. Complications.
   1. Chronic renal failure.
   2. Circulatory overload (pulmonary edema) and congestive heart failure (CHF).
   3. Hypertensive episodes.

Treatment
A. Medical.
   1. Diuretics for severe edema and fluid overload.
   2. Antihypertensives.
   3. Antibiotics, if the streptococcal infection is still present.
   4. Plasmapheresis for filtering out immune complexes (antigens and antibodies).
B. Dietary.
   1. Decrease sodium intake.
   2. Protein restriction if client is azotemic; however, the anorexia that a child experiences frequently limits protein intake sufficiently.
   3. Foods containing large amounts of potassium are often restricted during the oliguric phase.
C. Children with normal blood pressure, adequate urine output, and mild symptoms are cared for at home.
D. Fluid restriction may be implemented if urinary output is decreased.

Nursing Interventions
Goal: To protect client’s kidneys by preventing secondary infections.
A. Antibiotic therapy if cultures are positive.
B. Child usually experiences fatigue and malaise and will voluntarily restrict activity.
C. Avoid medications that are nephrotoxic.
Goal: To maintain fluid balance.
A. Monitor intake and output; maintain diet and fluid restrictions.
B. Monitor renal function: check proteinuria, specific gravity, and color of urine; weigh client daily; if client has hypertension, check blood pressure every 2 to 4 hours.
C. Monitor serum potassium levels.
D. Frequently, the first sign of improvement is an increase in the urine output, which may progress to profuse diuresis.

Goal: To prevent complications and promote comfort.
A. Encourage verbalization of fears.
B. Decrease anxiety by explaining treatments and reassuring client and family that the majority of clients recover fully.
C. Most children recover spontaneously, and recurrences are uncommon.

Home Care
A. Teach parent or client symptoms to be reported to physician: nausea, fatigue, vomiting, decrease in urinary output, and symptoms of infection.
B. Explain the need for rest, good nutrition, and avoidance of people with respiratory tract infections.
C. Teach measures to prevent UTIs.
D. Instruct client in regard to diet, fluid needs, and medication therapy.
E. Teach client to perform dipstick urine test to monitor for protein.

Wilms’ Tumor (Nephroblastoma)

Nephroblastoma (Wilms’ tumor) is one of the most common intraabdominal tumors of childhood and is associated with congenital anomalies, especially those of the genitourinary tract. The treatment and survival rate are based on the stage of the tumor at the time it is diagnosed.
A. Risk factors/etiology.
   1. Associated with genitourinary anomalies.
   2. Majority of children (80%) are younger than 5 years; peak incidence at 3 years.
B. Clinical manifestations.
   1. Swelling or mass within the abdomen: firm, confined to one side of the abdomen, causing vague or no pain.
   2. Abdominal pain as tumor enlarges.

FIGURE 23-3 Glomerulonephritis. (From Zerwekh J, Claborn J: Memory notebook of nursing, vol 2, ed 3, Ingram, Texas, 2007, Nursing Education Consultants.)
3. Hematuria, pallor, anorexia, weight loss, and malaise occur as condition progresses.
4. Hypertension (63%).
C. Diagnostics (see Appendix 23-1).

Treatment
The survival rate greatly depends on the stage of the tumor at the time of diagnosis. If the tumor is diagnosed and treated in the early stages, there is a high survival rate (see Chapter 8).
A. Surgery.
1. Surgery is frequently scheduled within 24 to 48 hours after the diagnosis.
2. Nephrectomy: kidney is removed, but the adrenal gland may be spared, depending on the invasiveness of the tumor.
3. If both kidneys are involved, the less affected kidney is retained, and the more involved one is removed. Bilateral nephrectomy is a last resort.
B. Medical.
1. Preoperative and postoperative radiation therapy for large tumors.
2. Postoperative chemotherapy.

Nursing Interventions
Goal: To provide safe preoperative care.

Nursing Priority Post a sign above the bed that reads “Do Not Palpate Abdomen.”

A. Handle child carefully to prevent trauma to the tumor site.
B. Prepare child and family for the surgery, including anticipation of a large incision and dressing. ICU care immediately after surgery.
C. Assess vital signs, especially blood pressure, for indications of hypertension. If adrenal gland is removed, blood pressure may be labile.

Goal: To assess kidney function and to prevent infection.
A. Usual postoperative care for abdominal surgery.
B. Monitor for GI complications.
C. Provide good pulmonary hygiene because child is at increased risk for pulmonary infections postoperatively.
D. Vincristine is frequently used in chemotherapy; closely observe the child for the development of a paralytic ileus.
E. Child is at risk for intestinal obstruction from the vincristine-induced adynamic ileus. edema caused by radiation, or postsurgical adhesions.

Home Care
A. Teach parents effects of chemotherapy.
B. Child has only one kidney; teach parents how to protect renal function.
1. Signs and symptoms of UTI.
2. Methods to prevent UTIs.
3. Advise all health care providers of compromised renal function.
4. Prompt treatment of other infections.

Acute Renal Failure
A clinical syndrome with abrupt loss of renal function that may occur over several hours or days, characterized by uremia. The most common cause is hypotension and pre-renal hypovolemia or exposure to a nephrotoxin.

Phases of Acute Renal Failure
A. Oliguric phase.
1. Urinary output decreases to less than 400 mL per 24 hours.
2. Increase in BUN, creatinine, uric acid, potassium, and magnesium levels and presence of metabolic acidosis.
3. Duration is 1 to 3 weeks; the longer it lasts, the less favorable the recovery.

Older Adult Priority The older adult client loses the ability to concentrate urine; therefore urinary output may not be significantly reduced in this stage of renal failure.
4. Nonoliguric renal failure: referred to as high output failure; urine is dilute and renal disease is present. These clients usually recover quicker and have fewer complications.
B. Diuretic phase.
1. Often has a sudden onset within 2 to 6 weeks after oliguric phase. Diuresis up to 10 L/day; urine is very dilute.
2. Hypovolemia and hypotension may occur due to massive fluid losses.
3. BUN level stops increasing. Urinary creatinine clearance stabilizes.
4. Client must be monitored for hypokalemia and hyponatremia.
5. May last for 1 to 3 weeks.
C. Recovery (convalescent) phase.
1. Begins when the GFR increases. May take up to 12 months for renal function to stabilize.
2. There is usually some permanent loss of renal function, but remaining renal function is sufficient to maintain healthy life. The older adult is less likely to experience a return to full kidney function.
3. Complications: secondary infection, which is the most common cause of death.

Assessment
A. Risk factors/etiology.
1. Prerenal (renal ischemia).
   a. Circulatory volume depletion: caused by hemorrhage, dehydration.
   b. Decreased cardiac output: pump failure and/or CHF, especially in older adults.
   c. Decreased peripheral resistance: caused by septic shock, anaphylaxis, antihypertensives.
   d. Volume shifts: third spacing of fluid, gram-negative sepsis, hypoalbuminemia.
2. Intrarenal (kidney tissue disease).
   a. Acute tubular necrosis: caused by hemolytic blood transfusion reaction, nephrotoxic chemicals (carbon tetrachloride, arsenic, lead, mercury), nephrotoxic medication (aminoglycoside antibiotics, amphotericin B, and streptomycin), radiology contrast material.
   b. Infections: acute glomerulonephritis, pyelonephritis, CMV, candidiasis.
   c. Diseases that precipitate vascular changes (e.g., atherosclerosis, diabetes mellitus, hypertension).
3. Postrenal (obstructive problems).
   a. Urinary and renal calculi.
   b. Benign prostatic hypertrophy.
   c. Urethral stricture.
   d. Trauma resulting in obstruction.
   e. Bladder cancer, neuromuscular disorders.

**NURSING PRIORITY** Many disorders across the life span can precipitate acute renal failure. It is important to know who is at increased risk for developing renal failure and the initial symptoms. Renal failure is frequently incorporated into a test question as a complication of a variety of conditions.

B. Clinical manifestations (multiple body systems affected).
   1. Urinary: decreased urinary output (oliguria, less than 400 mL/day; in older adults, may be 600 to 700 mL/day).
      a. Intrarenal and postrenal failure: fixed specific gravity, increased sodium in the urine; proteinuria with glomerular membrane alteration, “muddy brown” casts.
      b. Prerenal failure: history of precipitating event; urine specific gravity may be high; high urinary sodium concentration and proteinuria.
      c. High output renal failure: the kidney no longer filters the urine; high urinary output, but the urine is dilute and does not contain waste products from filtering.
   2. Cardiovascular.
      a. Pericarditis, pericardial effusion.
      b. Arrhythmias caused by acidosis or hyperkalemia.
      c. CHF, hypotension followed by hypertension.
   3. Respiratory.
      a. Pulmonary edema caused by fluid overload.
      b. Kussmaul respiration caused by metabolic acidosis.
      c. Pleural effusions.
   4. Hematologic.
      a. Anemia caused by impaired erythropoietin.
      b. Leukocytosis, increased susceptibility to infection.
      c. Altered platelet function leading to bleeding tendencies.
   5. Neurologic.
      a. Decreased seizure threshold caused by uremia.
      b. Altered mentation, memory impairment, lethargy.
   6. Fluid and electrolyte imbalances.
      a. Fluid retention.
      b. Hyperkalemia.
      c. Hyponatremia (usually dilution).
      d. Metabolic acidosis from accumulation of acid waste products.

C. Diagnostics (see Appendix 23-1).

**Treatment**
A. Medical.
   1. Identify and treat precipitating cause of acute renal failure (management varies according to whether disorder is prerenal, intrarenal, or postrenal).
   2. Diuretic therapy may be used with fluid challenges.
   3. Decrease serum potassium level.
      a. Sodium polystyrene sulfonate (Kayexalate): a cation exchange resin given by mouth or retention enema.
      b. Sorbitol: an osmotic cathartic; may be given with exchange resins to induce diarrhea to eliminate potassium ions.
      c. IV hypertonic glucose and regular insulin may be administered to move potassium into the intracellular space; used for severe hyperkalemia.
   4. IV administration of sodium bicarbonate: corrects metabolic acidosis and causes electrolyte shift.
   5. IV dopamine to enhance renal perfusion. *Caution:* always check for correct concentration before beginning infusion (see Appendix 16-7).

B. Dietary.
   1. Fluid restriction; intake may be carefully calculated with output.
   2. Intake of protein, potassium, and sodium is regulated according to serum plasma levels.
   3. Increased intake of carbohydrates and protein of high biologic value.
   4. Dialysis (see Box 23-3): indications are volume overload, BUN level greater than 120 mg/dL, metabolic acidosis, increased potassium with electrocardiographic changes, pericardial effusion, and cardiac tamponade.

**Nursing Interventions**

**Goal:** To maintain client in functional homeostasis and monitor renal function.

A. Identify and monitor high-risk clients (any client with a transient or significant decrease in blood pressure, regardless of the precipitating cause).
B. Maintain accurate intake and output record.
C. Determine weight daily (client may lose 0.2 to 0.3 kg/day during oliguric phase).
D. Assess fluid balance (hypervolemia or hypovolemia), urine specific gravity, pulmonary status, cardiac output, mental status changes.
E. Assess status of electrolytes and renal parameters: serum potassium, BUN, creatinine, phosphate levels; evaluate fluctuations of serum sodium levels.
F. Evaluate for hypertension or hypotension.
Box 23-3  TYPES OF DIALYSIS

**Hemodialysis**
Circulation of the client’s blood through a compartment that contains an artificial semipermeable membrane surrounded by dialysate fluid, which removes excess body fluid by creating a pressure differential between the blood and the dialysate solution.

**Continuous Renal Replacement Therapy (CRRT)**
An alternative measure for treating acute renal failure. The uremic toxins are removed slowly and continuously. This allows for constant maintenance of acid-base and electrolyte balance in an unstable client. Can be used in conjunction with hemodialysis. There are two types: continuous arteriovenous hemofiltration (CAVH) and continuous venovenous hemofiltration (CVVH).

**Peritoneal Dialysis**
Utilization of the peritoneal cavity and the peritoneum as the semipermeable membrane that removes excess fluid.

**Continuous Ambulatory Peritoneal Dialysis**
The dialysate is infused into the abdomen and remains there for a specified time (2 to 6 hours). The dialysate is removed by gravity drainage after the prescribed time.

**Automated Peritoneal Dialysis**
Uses a peritoneal dialysis cycling machine. It can be done continuously, intermittently, or nightly. Most clients prefer to have the dialysis done at night.

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**Goal:** To provide emotional support.
A. Always explain procedures.
B. Provide honest information regarding progress of condition.
C. May take 3 to 12 months for recovery.
D. Encourage client to express fears and concerns regarding condition.

**Chronic Renal Failure**
Chronic renal failure is a progressive, irreversible reduction in renal function such that the kidneys are no longer able to maintain the body environment. The GFR gradually decreases as the nephrons are destroyed. The nephrons left intact are subjected to an increased workload, resulting in hypertrophy and inability to concentrate urine.

**Stages of Chronic Renal Failure**
A. Diminished renal reserve.
   1. Normal BUN and serum creatinine levels.
   2. Absence of symptoms.
   3. The healthier kidney tissue compensates for the diseased tissue.
   4. GFR 60% to 89% of normal.
B. Renal insufficiency.
   1. GFR is 25% of normal.
   2. BUN and serum creatinine levels are increased (azotemia); decreased urinary creatinine clearance.
   3. Mild anemia.
   4. Impaired urine concentration leading to nocturia, then polyuria.
   5. Headaches.
C. End-stage renal failure (uremia).
   1. GFR is less than 10% of normal.
      a. Severe azotemia.
      b. Hyperkalemia, hypernatremia, and hyperphosphatemia.
      c. Metabolic acidosis.
      d. Altered renin-angiotension system.
      e. Decreased erythropoietin production.
   2. Urinary system: specific gravity of urine fixed at 1.010; proteinuria, casts, pyuria, hematuria; oliguria eventually leads to anuria less than 100 mL/24 hr.
   3. Endocrine system.
      a. Hyperparathyroidism causes hypocalcemia and hyperphosphatemia resulting in demineralization of the bones (renal osteodystrophy).
      b. Hypothyroidism.
   4. Hematologic system: anemia and bleeding, infection.
   6. Gastrointestinal system: anorexia, nausea, vomiting, ammonia odor (uremic fetor) to the breath.
gastrointestinal bleeding, peptic ulcer disease, gastritis.
7. Metabolic system: hyperglycemia, hyperlipidemia, gout, hypoprothrombinemia, carbohydrate intolerance.
8. Neurologic system: general central nervous system depression and peripheral neuropathy, headaches, seizures, sleep disturbances.
10. Integumentary system: yellow/grey discoloration, pruritus, uremic frost, ecchymosis.
11. Psychologic changes: emotional lability, withdrawal, depression, and psychosis, personality and behavioral changes.

**Assessment**
A. Risk factors/etiology.
   1. Chronic hypertension and poorly controlled diabetes account for about 70% of cases of chronic renal failure.
   2. Chronic glomerulonephritis and pyelonephritis.
   3. Nephrosclerosis and renal artery disease.
   5. Renal disease caused by nephrotoxic drugs or chemicals.
   7. Chronic kidney disease (CKD) is more common in African Americans and Native Americans.
B. Diagnostics (see Appendix 23-1).
   1. Elevated blood sugar and triglyceride levels.
   2. Increased serum potassium level.
   3. Decreased hemoglobin and hematocrit.

**Treatment**
A. Medical.
   1. Measures to reduce serum potassium level (see discussion under acute renal failure).
   2. Antihypertensives (see Appendix 16-5).
   3. Diuretics: thiazide and loop diuretics may be used early in the course of disease.
   4. Erythropoietin (Epogen, Procrit, Aranesp) for treatment of anemia.
   5. Phosphate binders and supplemental vitamin D for renal osteodystrophy.
B. Dietary.
   1. Problems with the client losing body weight, both adipose tissue and muscle mass.
   2. Restricted protein intake; may vary from just a decrease in protein intake to a specific restriction of 20 to 40 g/day.
   3. Protein should be of a high biologic value (1.2 to 1.3 g/kg); this enhances the utilization of the amino acids and results in formation of fewer nitrogen waste products.
   4. Fluid restriction: 600 to 1000 mL, adjusted according to urinary output and/or dialysis.
   5. Sodium and potassium restriction: based on laboratory values.
C. Dialysis (see Box 23-3).
D. Surgical: kidney transplantation—the primary limiting factor in the number of transplants done is the availability of kidneys; the average wait is 18 months to 4 years; clients with blood types B and O have the longest wait.
   1. Recipient criteria: candidates are evaluated on an individual basis as to how well they would benefit from transplantation.
      a. Candidates are usually younger than 70 years, have a life expectancy of at least 2 more years, and have reasonable expectations that the transplantation will improve the quality of life.
      b. Infection, disseminated malignancy, refractory cardiac disease, chronic respiratory failure, and unresolved psychologic disorders are contraindications to transplantation; the presence of hepatitis B or C is not contraindicated if controlled.
   2. Donor criteria: living related donors provide the best possible match with a 95% 1-year graft survival; when they are not available, cadaver donors are considered; these have a 90% 1-year graft survival.

**Nursing Interventions**
**Goal:** To assist the client to maintain homeostasis in early chronic renal failure.
A. Evaluate adequacy of fluid balance.
   1. Determine weight daily.
   2. Control hypertension.
   3. Discuss with the client how to monitor fluid intake and plan for the allocated amount to be distributed over the day.

**ALERT** Monitor hydration status, identify signs of fluid and electrolyte imbalance, and identify interventions to correct any imbalance.

B. Encourage nutritional intake within dietary guidelines.
   1. Relieve gastrointestinal dysfunctions before serving meals.
   2. Plan diet according to client’s preferences, if possible.
   3. Advise client that most salt substitutes contain potassium and should not be used.
C. Prevent problem of constipation.
   1. Include bran/fiber in diet.
   2. Stool softeners.
D. Avoid use of sedatives and hypnotics; increased sensitivity to these medications is caused by decreased ability of kidney to metabolize and excrete them.
E. Monitor electrolyte balance, especially levels of potassium and calcium.

**NURSING PRIORITY** Hypocalcemia and hyperkalemia are critical problems and may cause fatal dysrhythmias.
F. Assess cardiovascular status to determine how effectively the client’s cardiovascular system is compensating for the
increased fluid load and increased workload from the chronic anemic state.

G. Assess client for bleeding tendencies initially related to a decrease in production of erythropoietin and decreased platelet adhesiveness. Encourage intake of folic acid (1 mg daily) for red blood cell production and integrity.

H. Evaluate client for pruritus and assist with measures to decrease skin irritation and itching.

I. Avoid products containing magnesium (antacids).

J. Assess client’s activity tolerance in relation to anemia.

**Goal:** To provide emotional support and to promote psychologic equilibrium.

A. Encourage client to express concerns.

B. Recognize that the long-term management of a chronic disease may lead to anxiety and depression.

C. Encourage ventilation of feelings regarding lifestyle changes.

D. Encourage client and family members to seek out support groups and community resources, as well as other clients with renal failure who are undergoing the same types of treatment.

**Renal Transplant**

The transplantation of a kidney from a compatible-blood-typed deceased donor, blood relative, or a live donor. Transplanted kidney is usually placed extraperitoneally in the iliac fossa (usually right side to facilitate anastomoses and decrease occurrence of ileus).

**Assessment**

A. Recipient selection: based on a variety of factors—history of disseminated malignancies, untreated cardiac disease, chronic respiratory failure, extensive vascular disease, chronic infection, and noncompliance with medical regimens would contraindicate a transplant.

B. Rejection.

   a. Occurs within minutes to hours after transplant.
   b. No treatment; transplanted kidney removed.

2. Acute rejection: mediated by cytotoxic T lymphocytes.
   a. Can occur within days; 3 months is most common time, but can be as late as 2 years; it is common to have at least one rejection episode.
   b. Increased white blood cell count, fever.
   c. Deteriorating renal function: increasing serum creatinine and BUN levels, increasing blood pressure.
   d. Tenderness over graft site—often an early sign, along with malaise.
   e. Hypertension.
   f. Treatment is increased immunosuppressive therapy: usually high-dose steroids, polyclonal or monoclonal antibody therapy.

3. Chronic rejection: mediated by B cells and some T cells.

a. Occurs over months or years and is due to gradual occlusion of the renal vasculature. It is irreversible, and the client will again require dialysis and/or be placed back on the transplant list.

b. Hypertension, increasing serum creatinine and BUN levels, and proteinuria.

c. Graft tenderness, malaise, and signs of early end-stage renal disease.

d. Treatment is supportive.

- (1) Change immunosuppressive therapy or increase doses.
- (2) Add tacrolimus (Prograf) or mycophenolate mofetil (CellCept).

**Treatment**

A. Immunosuppressant medications (Appendix 23–3).

B. Steroids (Appendix 6–7).

**Nursing Interventions**

**Goal:** To provide preoperative care for client scheduled for kidney transplantation.

A. Maintain client’s metabolic state as close to homeostasis as possible; continue with dialysis.

B. Tissue typing and antibody screening are conducted to determine histocompatibility of the donor and recipient.

C. Immunosuppressant drugs: may be started prior to surgery.

D. Conduct routine preoperative procedures, including labeling the arm with vascular access for dialysis, because the client may require dialysis in the immediate postoperative period.

**Goal:** To provide postoperative care for the kidney transplant recipient.

A. Immunosuppressant therapy is continued indefinitely; the most frequent combination of maintenance therapy consists of azathioprine, cyclosporine, and prednisone.

B. Assess for renal graft function.


2. Cadaveric transplant recipients may need dialysis because of acute tubular necrosis until the transplanted kidney begins to function.

3. A sudden decrease or change in urine output should be reported.

C. Monitor for rejection.

D. Prevent and monitor for infection (UTI, pneumonia, and sepsis are biggest threats in the early posttransplantation period; fungal and viral infections are also common).

1. It is important to make a distinction between infection and rejection, because impaired renal function and fever occur in both.

2. Symptoms of septicemia: infection, shaking, chills, fever, tachycardia, leukocytosis, and tachypnea.

E. Atherosclerotic cardiovascular disease is common in transplant recipients. It is the leading cause of death in these clients.
F. Promote adaptation and psychologic support for the client who has undergone successful transplantation.
1. Often, there is a continual fear of possible rejection.
2. A major concern of the client and the family is related to long-term use of immunosuppressant medication, which puts tremendous psychologic and financial stress on the family.
3. Refer client to community and national agencies: National Association of Patients of Hemodialysis and Transplantation, Inc. and the National Kidney Foundation.

Dialysis

Dialysis is the passage of particles (ions) from an area of high concentration to an area of low concentration across a semipermeable membrane.

A. Water, by osmosis, will move toward the solution in which the ion concentration is the greatest.

B. When hemodialysis is performed, the semipermeable membrane used has pores that are large enough for waste products and water to move through but too small for blood cells and protein molecules to pass through. In peritoneal dialysis, the same process occurs, except that the client’s own intraabdominal peritoneal membrane is used and protein is lost due to the pore size.

C. Indications.
1. GFR less than 15 mL/min.
2. Fluid volume overload.
3. Serum potassium level greater than 6 mEq/L.
4. BUN level greater than 120 mg/dL.
5. Uremia, uncontrolled hypertension, and metabolic acidosis.

D. Types of dialysis (Box 23-3). Note that dialysis solutions are High-Alert Medications.

Nursing Interventions

Goal: To remove waste products of metabolism and excess fluid; to maintain a safe concentration of blood components.

A. Peritoneal dialysis.
1. Prepare client for procedure: establish baseline criteria of lab values, weight, and vital signs; bowel and bladder should be empty.
2. Provide support and information to the client when the peritoneal catheter is first inserted.
   a. Permanent peritoneal catheters are fitted with a device to keep them in place; types of catheters—bent neck, curl, and disc.
   b. Temporary peritoneal catheters are inserted, and usually, a purse-string suture holds them in place; this usually occurs in the intensive care unit.
3. Type of peritoneal dialysis being used and the physical stability of the client determine how long each cycle of dialysis will take.
   a. Cycle is initiated with the inflow of the dialysate by gravity into the abdominal cavity. The client should be carefully observed during the initial infusion to determine how well he or she will tolerate the additional fluid in the abdominal cavity. Initial infusion is usually 1 to 2 L over 10 to 20 minutes (fill time).
   b. The dialysate remains in the abdomen (dwell time) and is allowed to drain by gravity (drain time). The dwell time and drain time are specified in the doctor’s orders. Seriously ill clients may receive up to 24 exchanges in a day.
   c. One exchange constitutes infusion, dwell time, and drainage.
   d. The dialysate should be warmed to body temperature before it is infused (do not use a microwave oven) to increase clearance.
   e. The procedure should be considered sterile in that masks and sterile gloves should be used when accessing the catheter to change the tubing. Remember the catheter is an open conduit to the peritoneal cavity.

4. Insufficient outflow.
   a. Constipation is the primary cause of inflow and outflow problems.
   b. Check the tubing for patency and keep drainage bag below the level of the abdomen.
   c. Turn client from side to side or put client in semi-Fowler’s position to increase abdominal pressure.
   d. Gently massaging the abdomen can also help.

5. Complications: possible bowel perforation from catheter insertion, peritonitis, bleeding, hypoalbuminemia, hyperglycemia in clients with diabetes.

NURSING PRIORITY If dialysate is left in the peritoneal cavity too long, then hyperglycemia may occur. Heparinization is not required for peritoneal dialysis, as it is for hemodialysis.

B. Hemodialysis.
1. Vascular access site must be established; access may be temporary or permanent (Figure 23-4).
   a. External arteriovenous shunts: temporary catheters are inserted into an artery and into a vein and are connected together on the outside of the arm in a U pattern.
   b. Internal arteriovenous fistula or graft: an artery and a vein in the arm are anastomosed either directly or via a synthetic graft; access is achieved via two 14- to 16-gauge needles inserted into the access site.
   c. After an internal access site is created, it must heal before it can be used for dialysis.
2. Evaluate access site for patency: the appropriate method to determine patency depends on the type of vascular access used; auscultate for bruit or palpate for a thrill over site.
3. Do not take blood pressure, obtain blood samples, or infuse fluids or medications in the access site or the extremity that has a vascular access site.
4. Assess the patency of the pulses distal to the access site.
**Goal:** To maintain homeostasis after hemodialysis.

A. Determine whether medications need to be withheld before dialysis (antihypertensives); in hospitalized clients there are often standing orders for these situations.

B. Assess weight, blood pressure, peripheral edema, lung and heart sounds, and vascular access site before and after dialysis.

C. Most common side effects are hypotension, headache, muscle cramps, and bleeding from access site; monitor client for postural hypotension. If client has bleeding from the access site, apply pressure evenly and notify the dialysis unit.

D. Complications.
   1. Dialysis disequilibrium syndrome: cerebral edema and neurologic complications (headache, nausea, vomiting, seizures); may be minimized by slower dialysis.
   2. Sepsis, hepatitis B and C.

**Goal:** To maintain homeostasis during and after peritoneal dialysis.

A. Pain is common during first few exchanges; should gradually decrease.

B. Assess for development of peritonitis; antibiotics may be added to dialysate.

C. Dialysate should return clear to slightly yellow tinged; should not be cloudy or opaque.

D. Closely monitor blood pressure and activity after dialysis.

E. Increase protein in diet to compensate for removal of protein in dialysis; low protein level will impair tissue healing.

**Goal:** To provide emotional support and to promote psychologic equilibrium.

A. Encourage client to express feelings of anger and depression. An increased rate of suicide exists among clients undergoing dialysis.

B. Encourage appropriate coping skills.

C. Clients undergoing chronic dialysis are in limbo; they know they are probably not going to get better and that they may or may not receive a transplant. Frequently, they have ambivalent feelings about dialysis; it maintains life but severely restricts lifestyle.

### Renal Tumors

The majority of renal tumors are malignant and occur more frequently in men between the ages of 50 and 70 years. Most often, the tumor begins in the renal cortex, where it can actually become quite large before it begins to compress the adjacent renal tissue. The most common areas of metastasis are the liver, lungs, and bone, especially the mediastinum.

**Risk Factors**

A. Cigarette smoking is one of the most significant risk factors.

B. Obesity.

C. Exposure to asbestos, cadmium, and gasoline.
Assessment
A. Clinical manifestations.
1. Palpable abdominal mass.
3. Weight loss, weakness, anemia, hypertension.
B. Diagnostics (see Appendix 23-1).

Treatment
A. Medical.
1. Palliative radiation therapy.
2. Biologic therapy with alpha interferon and interleukin-2.
B. Surgical: radical nephrectomy (includes kidney, adrenal gland, ureter, lymph nodes, and surrounding fascia).

Nursing Interventions
**Goal:** To provide preoperative nursing care (see Chapter 3).
A. Inform client that flank incision will be on affected side and that surgery will be performed in a hyperextended, side-lying position.

B. Often, client experiences postoperative muscle aches and discomfort as a result of surgical positioning.
C. Radiation, biologic therapy, or both after surgery.

**Goal:** To provide postoperative care.
A. Urinary output is important to assess; catheters should be labeled, and drainage should be recorded accurately.
B. Because of the level of the incision, respiratory complications are common; encourage coughing and deep breathing, as well as incentive spirometry, every 2 hours while client is awake.
C. Assess for abdominal distention and paralytic ileus.
D. Monitor for unstable blood pressure after surgery; may be caused by removal of adrenal gland.
E. Provide adequate pain control.

**Goal:** To provide supportive nursing care in relation to malignancy.
See Chapter 8 for detailed nursing management.

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**Appendix 23-1  DIAGNOSTICS OF THE URINARY-RENAL SYSTEM**

<table>
<thead>
<tr>
<th>LABORATORY TESTS</th>
<th>NORMAL</th>
<th>CLINICAL AND NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUN level</td>
<td>10-20 mg/dL</td>
<td>Common test used to diagnose renal problems; may be affected by an increase in protein intake or tissue breakdown.</td>
</tr>
<tr>
<td>Creatinine level</td>
<td>0.5-1.5 mg/dL</td>
<td>End product of protein and muscle catabolism; more accurate determinate of renal function than the BUN level; values are higher in males. Elevated in renal disease. Provides the matrix for bone and is important in muscle contraction, neurotransmission, and clotting; in chronic renal failure, low levels of calcium lead to renal osteodystrophy. Phosphorus and calcium balances are inversely related; when phosphorus level is elevated, calcium level is decreased, which is seen in renal disease.</td>
</tr>
<tr>
<td>Calcium level</td>
<td>9-11 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Phosphorus level</td>
<td>2.5-4.8 mg/dL</td>
<td></td>
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<tr>
<td>Urinalysis</td>
<td></td>
<td></td>
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<tr>
<td>Urine culture and sensitivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urinary creatinine clearance</td>
<td>Males: 21-26 mg/kg/24 hr Females: 16-22 mg/kg/24 hr</td>
<td>Measure of GFR; 24-hour urine collection must be done; have client void and discard the first specimen and then begin timing the test; specimens should be kept cool or refrigerated. Decreased in renal disease.</td>
</tr>
<tr>
<td>Urine specific gravity</td>
<td>Adults: 1.003-1.030 Children: 1.001-1.030</td>
<td>May be increased when the client is dehydrated and with glomerulonephritis. A decrease is associated with decreased tubular absorption. In renal failure it may be fixed at 1.000 to 1.012. Proteinuria will increase the specific gravity.</td>
</tr>
</tbody>
</table>
**Laboratory Diagnostics**

**PROCEDURE**

**KUB x-ray exam:** A flat plate x-ray film of the abdomen and pelvis.

**Intravenous urography (IVP or excretory urogram):** IV injection of radiopaque dye to visualize the urinary tract system.

**Retrograde pyelogram:** An x-ray study of the urinary tract conducted during a cystoscopic exam; ureteral catheters are inserted into the renal pelvis, and dye is injected (retrograde) into the catheters.

**Renal arteriogram (angiogram):** An IV injection of radiopaque dye into the renal artery (catheter is inserted into femoral artery) to visualize the renal blood vessels.

**Renogram (renal scan):** An IV injection of a radioactive nuclide (isotope) followed by use of a scanning device to detect radioactive emissions from the kidney(s); identifies renal blood flow, tubular functions, and renal excretion.

**Cystoscopy:** A direct method to visualize the urethra and bladder by use of a tubular lighted scope (cystoscope). Scope may be inserted via the urethra or percutaneously.

**Bladder scan:** A portable ultrasound scanner used to estimate residual urine in the bladder.

**Urodynamic studies**

**Cystometrogram (CMG):** A procedure to determine the pressure exerted against the bladder wall by inserting a catheter and instilling water or saline solution; used to evaluate bladder capacity, bladder pressure, and voiding reflexes.

**Urethral pressure profile or urethral pressure profilometry (UPP):** Evaluates for urinary incontinence and retention by recording variations of pressure in the urethra.

**Urine stream testing:** Evaluates pelvic floor muscle strength.

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**CLINICAL AND NURSING IMPLICATIONS**

Bowel preparation may or may not be indicated.

1. Client’s status is NPO for 8 hours before procedure.
2. Cathartic or enema given the evening before procedure.
3. Radiocontrast medium may cause an allergic (hypoallergenic) reaction in iodine-sensitive clients.
4. Instruct client that he or she will need to lie still on table while serial x-ray films are taken.
5. Evaluate for iodine reaction after test and force fluids after test to flush out the dye.
6. Be sure the older adult client is not dehydrated before the procedure; the contrast medium is nephrotoxic and can precipitate renal failure.

1. Client’s status is NPO for 8 hours before test.
2. Assess for sensitivity to iodine.
3. Explain that there may be discomfort on insertion of the cystoscope.
4. General anesthesia may be indicated for procedure.
5. Client’s status is NPO after midnight.
6. Preoperative medication is administered.
7. Client should be assessed for sensitivity to iodine before the procedure.
8. Evaluate venipuncture insertion site every 15 to 30 min after the procedure to assess for bleeding.
9. Assess pulses distal to the injection site to detect occluded blood flow. Compare pre- and postprocedure pulses.
10. Sandbag or pressure dressing may be applied to groin.
11. No specific activity or dietary restrictions.
12. Explain procedure to client.

1. Force fluids or administer fluids intravenously.
2. Explain lithotomy position that will be used.
3. Client may have general anesthesia or conscious sedation.
4. Preoperative medication is given.
5. Evaluate urine output after procedure; check for frequency, pink-tinged urine, and burning on urination (these are expected effects and will decrease with time).
6. Evaluate for orthostatic hypotension and thrombus formation after the procedure.
7. Provide warm sitz baths and mild analgesics to alleviate urethral discomfort.
8. No specific preparation.
9. After client voids, apply gel to the suprapubic area, and use scanner to visualize bladder and possible retained urine.
10. Make certain that the crosshairs on the aiming icon on the scanner are centered on or over the bladder; if crosshairs are offset then the reading may not be accurate.
11. Assess and evaluate for UTI after procedure.
12. Test is often indicated for clients having difficulty with urinary control (e.g., those with spinal cord traumatic injuries, stroke, etc.).

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**Appendix 23-1  DIAGNOSTICS OF THE URINARY-RENAL SYSTEM—cont’d**

Continued
**Appendix 23-1  DIAGNOSTICS OF THE URINARY-RENAL SYSTEM—cont’d**

**PROCEDURE**

**Renal biopsy:** A percutaneous needle biopsy to evaluate renal disease by obtaining a specimen of renal tissue for pathologic examination. Rarely done if client has only one kidney.

**Renal ultrasound exam:** A noninvasive procedure in which ultrasound waves are used, with the aid of a computer, to record images related to tissue density.

**CLINICAL AND NURSING IMPLICATIONS**

1. Results of blood coagulation studies should be available on the chart before the biopsy procedure.
2. Results of IVP or ultrasound studies should be available before the biopsy.
3. Immediately after the procedure, pressure dressing is applied to biopsy site and checked frequently for bleeding. Right kidney is the usual biopsy site.
4. Assess for gross hematuria, flank pain, or a rise or fall in blood pressure.
5. Report pain radiating from the flank area to the abdomen.
6. Encourage intake of fluids: 3000 mL per day unless the client has renal insufficiency.
7. Assess for complication of hemorrhage; may necessitate emergency surgical drainage or nephrectomy.

**NURSING IMPLICATIONS**

1. Encourage fluids because test requires a full bladder.
2. Place in prone position.
3. Skin care to remove sonographic gel after procedure.

_BUN, Blood urea nitrogen; GFR, glomerular filtration rate; IV, intravenous; IVP, intravenous pyelogram; KUB, kidneys, ureters, and bladder; NPO, nothing by mouth; UTI, urinary tract infection._

**Appendix 23-2  RENAL MEDICATIONS**

**General Nursing Implications**

— Encourage intake of 2000-3000 mL of fluid per day during treatment.
— Continue medication therapy until all medication has been taken.
— Most medications are better absorbed on an empty stomach; however, if GI distress occurs, they may be taken with food.
— Monitor intake and output, as well as symptoms of increasing renal problems.
— Check drug package insert for interactions with anticoagulants.
— See Appendix 6-9 for sulphonamide medications for UTI.

**MEDICATIONS**

**Urinary Tract Antiseptics** These drugs concentrate in the urine and are active against common urinary tract pathogens; they do not affect infections in blood or tissue.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrofurantoin (Furadantin, Macrodantin, APO-Nitrofurantoin, Nitrofan): PO, IM</td>
<td>GI upset, blood dyscrasia, pulmonary reactions</td>
<td>1. Requires adequate renal function to concentrate medication in urine. 2. Should not be administered to renal transplant recipients. 3. Will turn the urine brownish-orange.</td>
</tr>
</tbody>
</table>

**Urinary Analgesics** Pain relievers typically used on urinary tract mucosa.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
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</table>

**Available OTC**
CHAPTER 23 Urinary-Renal System

Appendix 23-2 RENAL MEDICATIONS—cont’d

<table>
<thead>
<tr>
<th>MEDICATIONS</th>
<th>SIDE EFFECTS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bladder Relaxants</strong></td>
<td>Suppress detrusor contractions and enhance bladder storage (drugs with anticholinergic activity).</td>
<td></td>
</tr>
<tr>
<td>Oxybutynin (Ditropan, Ditropan XL): PO, transdermal</td>
<td>Drowsiness, dizziness, weakness, blurred vision, dry mouth, constipation</td>
<td>1. Contraindicated in glaucoma, myasthenia gravis, or GI obstruction. 2. Used cautiously in older adults. 3. Can relieve bladder spasms in surgical clients. 4. Monitor intraocular pressure.</td>
</tr>
<tr>
<td>Tolterodine (Detrol, Detrol LA): PO</td>
<td>Fatigue, headache, dry mouth, dry eyes, constipation</td>
<td>1. Grapefruit juice can increase blood levels. 2. Caution client to avoid use of alcohol or OTC antihistamines.</td>
</tr>
<tr>
<td>Solifenacin succinate (Vesicare): PO</td>
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</table>

**Glycoprotein Hormones** Stimulate bone marrow production of RBCs.

<table>
<thead>
<tr>
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<th>ACTION</th>
<th>SIDE EFFECTS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoetin alfa (Epogen, Procrit): IV, subQ</td>
<td>Inhibits RNA and DNA protein synthesis</td>
<td>Hypertension, thromboembolic problems, headaches, GI disturbances</td>
<td>1. Closely evaluate hemodialysis access ports for clotting. 2. Evaluate client for adequate serum iron level, hematocrit, and blood pressure; adequate levels are required for medication to be effective. 3. Uses: Maintain hemoglobin and hematocrit values in client with renal failure and those who are HIV+ or on chemotherapy. Do not administer if Hgb is 12 or greater.</td>
</tr>
</tbody>
</table>

GI, Gastrointestinal; HIV+, human immunodeficiency virus–positive; IV, intravenously; PO, by mouth (orally); subQ, subcutaneously; UTI, urinary tract infection.

Appendix 23-3 IMMUNOSUPPRESSIVE MEDICATIONS

**General Nursing Implications**
— Avoid exposure to infection; wash hands frequently.
— Wear protective clothing; use sunscreen.
— Report any sore throat, fever, or other signs of infection to health care provider.
— Take medication at the same time each day to maintain consistent blood levels.
— No live virus vaccines or immunity-conferring agents should be administered while client is immunosuppressed.
— Depending on level of immunosuppression, client may need protective isolation.

<table>
<thead>
<tr>
<th>MEDICATIONS</th>
<th>ACTION</th>
<th>SIDE EFFECTS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azathioprine (Imuran): PO, IV</td>
<td>Inhibits RNA and DNA protein synthesis</td>
<td>Dose- and duration-dependent Bone marrow suppression: leukopenia, thrombocytopenia, anemia Nausea, vomiting, anorexia Alopecia, rash</td>
<td>1. Interacts with allopurinol, causing an increase in Imuran toxicity. 2. Avoid use in pregnancy. 3. Take with food or milk to decrease GI upset. 4. Should not be given to client with active infection. 5. Follow-up CBCs should be done at least monthly while client is taking medication. 6. Closely monitor client for development of infections.</td>
</tr>
<tr>
<td>Suppresses T-cell (cell-mediated) production Antiinflammatory properties Used to suppress kidney transplant rejection and treat IBS and RA</td>
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<thead>
<tr>
<th>MEDICATIONS</th>
<th>ACTION</th>
<th>SIDE EFFECTS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclosporine (Sandimmune, Neoral): PO, IV</td>
<td>Inhibits T-lymphocyte proliferation and function</td>
<td>Dose- and duration-dependent Infections, nephrotoxicity, hepatotoxicity, hypertension, hirsutism, gum hyperplasia, tremors, blood dyscrasias</td>
<td>1. Monitor renal function because nephrotoxicity occurs frequently. 2. Avoid use in pregnancy. 3. Use the pipette supplied by manufacturer to measure dose; mix with 4-8 oz. of water, milk, or juice. 4. Evaluate blood pressure and report elevations (especially occurs with heart transplants). 5. Monitor liver function studies. 6. Good oral hygiene should be practiced to reduce gum problems. 7. Teach client that he/she should not stop taking the medication or change dosage without physician's order. 8. Serum blood levels and CBC are monitored at regular intervals. 9. Hirsutism that occurs is reversible.</td>
</tr>
<tr>
<td>Methotrexate (Mexate)</td>
<td>See Appendix 8-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclophosphamide (Cytoxan)</td>
<td>See Appendix 8-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antilymphocyte globulin (ALG)</td>
<td>Polyclonal antibody that blocks function of T cell by reacting with T, antigen</td>
<td>Fever, chills, tachycardia, hypotension, bronchospasm</td>
<td>1. More than 50% of clients experience a fever. 2. Have epinephrine and supportive emergency care available, because an allergic reaction can occur at any time during therapy. 3. Administer slowly over 4-6 hr. 4. Client may be premedicated with acetaminophen, diphenhydramine HCl, or methylprednisolone.</td>
</tr>
<tr>
<td>Murine monoclonal anti-lymphocyte therapy (OKT3) Daclizumab (Zenapax)</td>
<td>Monoclonal antibody that binds to CD3 receptors and inhibits T-cell proliferation</td>
<td>Aseptic meningitis (OKT3) GI toxicity (diarrhea, nausea, abdominal pain)</td>
<td></td>
</tr>
<tr>
<td>Methylprednisolone sodium (Solu-Medrol)</td>
<td>See Appendix 6-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tacrolimus (Prograf, FK506)</td>
<td>Inhibits T-lymphocyte production</td>
<td>Hepatotoxicity, nephrotoxicity, neurotoxicity, hyperglycemia, seizures, hypertension, GI effects</td>
<td>1. Monitor blood pressure closely. 2. Increases risk for infection.</td>
</tr>
<tr>
<td>Sirolimus (Rapamune)</td>
<td>Suppresses lymphocyte proliferation; inhibits B cells from synthesizing antibodies</td>
<td>GI toxicity (diarrhea, nausea, vomiting, abdominal pain)</td>
<td>1. Has synergistic effect with cyclosporine and corticosteroids. 2. Increases risk for infection. 3. Increases cholesterol levels.</td>
</tr>
<tr>
<td>Mycophenolate mofetil (CellCept)</td>
<td>Antimetabolite that inhibits DNA and RNA synthesis</td>
<td>Leukopenia, thrombocytopenia, GI (diarrhea, nausea, vomiting), UTI, hypertension, peripheral edema</td>
<td>1. Usually used in combination with cyclosporine, tacrolimus, sirolimus, or glucocorticoids. 2. Give on an empty stomach.</td>
</tr>
</tbody>
</table>

CBC, Complete blood counts; GI, gastrointestinal; IL-2, interleukin 2; IV, intravenous; PO, by mouth (orally); RA, rheumatoid arthritis; UTI, urinary tract infection.
A urinary diversion is a means of diverting urinary output from the bladder to an external device or via a new avenue (Figure 23-5).

**Temporary Urinary Diversion**

Nephrostomy tubes (catheters): Insertion of catheters into the renal pelvis by surgical incision or percutaneous puncture. A small catheter is inserted into the renal pelvis and attached via connecting tubing to a closed-system drainage. Nephrostomy tubes may be temporary or permanent.

**Nursing Implications**
1. Catheter should never be clamped or irrigated (renal pelvis capacity is 3 to 5 mL).
2. Complications: Infection and secondary renal calculus formation; erosion of the duct by the catheter.

**Ureteral catheters:** Small, narrow catheters placed through the ureters into the renal pelvis; drain each renal pelvis individually. Often client also has a urinary retention catheter draining the urinary bladder. The catheter splints the ureters during healing and prevents edema from occluding the ureter.

**Permanent Urinary Diversion**

Ileal conduit (ileal loop): Transplantation of ureters into a segment of ileum or colon, which is then brought to the abdomen; a stoma is then constructed.

**Nursing Implications**
1. Stoma site is marked before surgery, because a device must be worn continuously.
2. Mucus is present in the urine after surgery when ileum segment is used; encourage a high fluid intake to “flush the ileal conduit.”
4. Provide discharge instructions in regard to symptoms of obstruction, infection, and care of the ostomy; client needs information relating to purchase of supplies, ostomy clubs, follow-up visits, enterostomal therapists, and the importance of not irrigating the ileal conduit.

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**FIGURE 23-6** Creation of a Kock pouch with implantation of ureters into one intussuscepted portion of the pouch and creation of a stoma with the other intussuscepted portion. (From Lewis SL et al: Medical-surgical nursing: assessment and management of clinical problems, ed 7, St. Louis, 2007, Mosby.)

Continued
**Appendix 23-4 URINARY DIVERSION—cont’d**

**Continent Urinary Diversion**

Kock, Mainz, Indiana, or Florida pouch: A segment of the bowel is made into a reservoir; client is taught to use a catheter to drain the pouch and maintain continence (Figure 23-6). The main difference among the diversions is the segment of intestine utilized (ileum, ileocecal segment, or colon).

**Nursing Implications**
1. Client will not need to wear an appliance but will need to self-catheterize every 4 to 6 hours.
2. A small bandage/pouch may be worn to collect any mucus drainage or small leaks.

3. Continuous assessment of status of skin around stoma.
4. Client should understand how to care for the stoma before he or she leaves the hospital:
   - Know how continent diversion functions and how to prevent complications.
   - Increase fluid intake.
   - Contact health care provider if there are changes in the color of the stoma or if urine becomes dark and foul smelling.
5. A catheter will be inserted into the reservoir every 4 to 6 hours to drain urine.

**Appendix 23-5 NURSING PROCEDURE: URINE SPECIMEN COLLECTION**

**✓ KEY POINTS:** Random Sample
- May be collected at any time.
- Client may be specifically ordered to collect first voided specimen or to collect sample on second voiding.

**✓ KEY POINTS:** Clean Catch and Midstream
- Specimen is collected for culture.
- Cleanse urinary meatus before specimen collection.
- For midstream collection, tell client to start the urinary stream and collect the specimen after voiding has begun. Regardless of how well the urinary meatus is cleansed, the specimen must be a midstream collection or the specimen will be contaminated with the bacteria in the urethra.

**✓ KEY POINTS:** Catheterized Specimen
- Straight in-and-out catheterization to obtain sample for culture.
- Procedure is discouraged because of introduction of bacteria and irritation producing a urinary tract infection. More common in infants and children and those unable to provide a midstream specimen.

**✓ KEY POINTS:** 12- to 24-Hour Collection
- When the collection time is started, have the client void, discard the urine, and start the collection with the next voiding.
- Mark the collection container and collect the urine over the prescribed time frame.
- When the time frame is completed, have the client void again, add it to the specimen collection, and send to lab for evaluation.

**ALERT** Collection of urine specimens is a common nursing action; be sure to know why the sample is being obtained and the type of diagnostic test for which it is being collected.

**Appendix 23-6 NURSING PROCEDURE: URINARY CATHETERIZATION**

**✓ KEY POINTS:** Insertion of a Retention Catheter
- A sterile procedure.
- Lubricate catheter with sterile lubricant provided in tray.

**ALERT** Insert a urinary catheter.

- Cleanse the meatus:
  - For a Female
    1. Cleanse the meatus with sterile cotton ball held in forceps; use one downward stroke of the forceps.
    2. Repeat at least three to four times using new sterile cotton ball each time.
    3. Continue to hold the labia apart until you insert the catheter.
    4. When urine appears, advance the catheter another 1 to 2 inches.
  - For a Male
    1. Hold the penis upright. Hold the sides of the penis to prevent closing the urethra.
    2. Cleanse the meatus in a circular motion from urinary meatus to glans with sterile cotton ball held in forceps; use one downward stroke of the forceps.
    3. Repeat at least three to four times.

4. Continue to hold the penis until you insert the catheter.
5. Insert the catheter 1 to 2 inches beyond the point at which urine begins to flow. Inserting the catheter farther into the bladder ensures it is beyond the neck of the bladder.
6. Instill sterile water into balloon after catheter is inserted.

- Anchor the catheter.
  - For a female: Anchor or tape catheter to the side of the leg.
  - For a male: Anchor or tape catheter to the abdomen to prevent pressure on the penoscrotal angle.
- Attach drainage bag to bed frame (not side rails), so that it hangs freely, and below the level of the catheter.

**✓ KEY POINTS:** Providing Catheter Care
- Maintain external cleanliness around the catheter; wash thoroughly with mild soap and water when soiled—or at least once every 24 hours.
- Maintain closed system. Do not allow urine to flow from the bag or tubing back into the bladder.
- Encourage high fluid intake to maintain constant flow of urine. Increased flow of urine inhibits the upward movement of bacteria.
Appendix 23-6  NURSING PROCEDURE: URINARY CATHETERIZATION—cont’d

✓ KEY POINTS: Removal of a Catheter

- Clamp catheter.
- Do not cut the catheter with a scissors. Balloon may not totally deflate if cut.
- Withdraw fluid from balloon (usually 5 to 10 mL water in balloon.)
- Pull gently on catheter to ensure balloon is deflated before attempting to remove. Damage to the urethra can occur if balloon is not totally deflated. If the catheter has been in place for longer than 10 days, reinflate the balloon after removal to assess for degradation.
- Record output on intake and output (I&O) bedside record.
- Wash perineum with soap and water. Dry thoroughly.
- Instruct client to drink fluids as tolerated and observe for signs and symptoms of urinary tract infection (burning, frequency, urgency).
- Offer bedpan or urinal at least every 2 to 4 hours after removing catheter, until voiding occurs. Keep accurate I&O record.

Clinical Tips for Problem Solving

1. If catheter is inserted in the vagina of female client:
   - Leave the catheter in place so you do not reintroduce a new catheter into the vaginal area. Obtain a new catheter and sterile gloves.
   - If sterile field has been contaminated, obtain a whole new kit.

2. If unable to insert catheter into male client:
   - Obtain a new catheter kit.
     a. Hold penis vertical to the body.
     b. Insert catheter while applying slight traction by gently pulling upward on the shaft of the penis.
     c. If you encounter resistance, rotate the catheter, increase the traction, and change the angle of the penis slightly.
     d. When urine begins to flow, lower the penis.

3. If pain occurs during inflation of balloon:
   - Remove any injected water and insert the catheter farther into the bladder.

4. If urine exceeds 1000 mL with catheterization:
   - Clamp catheter for 20 to 30 minutes and then unclamp.

5. If catheter comes out with balloon still inflated:
   - Assess client for signs of urethral trauma (i.e., bleeding, pain).
   - Obtain a new catheter and repeat the catheterization procedure, making sure that the balloon is inflated with at least 10 mL water.
   - Monitor urine output for bleeding.

Study Questions  Urinary-Renal System

1. The client has had a right nephrostomy tube placed after a nephrolithotomy for removal of a kidney stone. When the client returns to the room, what is a priority nursing action?
   1. Irrigate the tube with 30 mL of normal saline solution four times a day.
   2. Clamp the tube if drainage is excessive.
   3. Advance the tube 1 inch every 8 hours.
   4. Ensure that the tube is draining freely.

2. The nurse is infusing dialysate during peritoneal dialysis. What is a nursing action to make the client more comfortable at this time?
   1. Increase the rate of flow.
   2. Raise the head of the bed.
   3. Turn the client from side to side.
   4. Refrigerate the fluid before infusion.

3. A client has had a kidney stone removed, and the nurse instructs him in measures to decrease kidney stone formation in the future. Which statement by the client indicates to the nurse that he understood the teaching?
   1. “I can continue to drink soda if it is sugar free.”
   2. “I should consume at least 3000 mL of fluid daily.”
   3. “I should report nocturia that occurs once a night.”
   4. “I will ingest megadoses of vitamins C and D daily.”

4. The nurse understands that the following clinical findings are indications for dialysis. Select all that apply:
   1. Volume overload
   2. Blood urea nitrogen level of 18 mg/dL
   3. Potassium level of 5.2 mEq/L
   4. Decreased creatinine clearance
   5. Metabolic acidosis
   6. Creatinine level of 5.0 mg/dL

5. A client in renal failure is to have a serum blood urea nitrogen level determined. What will this diagnostic test measure?
   1. Concentration of the urine osmolarity and electrolytes
   2. Serum level of the end products of protein metabolism
   3. Ability of the kidneys to concentrate urine
   4. Levels of C-reactive protein to determine inflammation

6. A client with chronic renal failure has an internal venous access site for hemodialysis on her left forearm. What action will the nurse take to protect this access site?
   1. Irrigate with heparin and normal saline solution every 8 hours.
   2. Apply warm moist packs to the area after hemodialysis.
   3. Do not use the left arm to take blood pressure readings.
   4. Keep the arm elevated above the level of the heart.
7. What nursing measure would be included in the plan of care for a client with acute renal failure?
1. Observe for signs of a secondary infection.
2. Provide a high-protein, low-carbohydrate diet.
3. In and out catheterization for residual urine
4. Encourage fluids to 2000 mL in 24 hours.

8. What will the nurse identify as the goal of treatment for a client with chronic renal insufficiency?
1. Increase the urine output by increasing liver and renal perfusion.
2. Prevent the loss of electrolytes across the basement membrane.
3. Increase the concentration of electrolytes in the urine.
4. Maintain present renal function and decrease renal workload.

9. The nurse is discussing the prevention of urinary tract infections with a female client. What would be important to include in the discussion?
1. Decrease fluid intake to decrease burning on urination.
2. Take warm sitz baths with a mild bubble bath.
4. Drink only acidic fluids such as orange juice.

10. At 9:00 a.m. a 24-hour urine collection is started. What instructions will the nurse provide to the client?
1. Place the first voided specimen in the container and continue to collect the urine until 9:00 a.m. the following day.
2. Discard the first morning specimen, collect urine for the next 24 hours, and make sure to void before the collection is completed at 9:00 a.m. the following day.
3. Discard the first morning specimen because it may contain concentrated abnormal components.
4. Collect all urine from 9:00 a.m. onward in separate containers that are labeled for time and amount of voiding.

11. Which nursing observations indicate that a male client with a kidney stone is experiencing renal colic?
1. Severe flank pain radiating toward the testicles
2. Stress incontinence with full bladder
3. Hematuria and severe burning on urination
4. Enuresis with hyperalbuminuria

12. The nurse is evaluating a client’s response to hemodialysis. The laboratory values reflect that dialysis is achieving positive results. Which lab values would not reflect changes resulting from the hemodialysis?
1. Serum creatinine levels
2. Sedimentation rate
3. Serum potassium levels
4. Hemoglobin levels

13. Which of the following are the signs and symptoms of cystitis? Select all that apply:
   _____ 1 Increased bladder capacity
   _____ 2 Frequency
   _____ 3 Dysuria
   _____ 4 Nocturia
   _____ 5 Urgency
   _____ 6 Polydipsia

14. A client with chronic renal failure has been prescribed calcium carbonate. What is the rationale for this particular medication?
1. Diminishes incidence of gastric ulcer formation
2. Alleviates constipation
3. Binds with phosphorus to lower concentrations
4. Increases tubular reabsorption of sodium

15. Which of the following is an appropriate nursing action for a child with glomerulonephritis?
1. Initiating contact isolation precautions
2. Encouraging increased fluid intake
3. Encouraging ambulation, as tolerated
4. Providing a high-calorie, low-protein diet

16. The nurse understands that a client may experience pain during peritoneal dialysis because of which of the following? Select all that apply:
   _____ 1 Warming the dialysate solution before administration
   _____ 2 Too-rapid instillation of the dialysate
   _____ 3 Infiltration of solution into the bloodstream
   _____ 4 Accumulation of dialysate solution under the diaphragm
   _____ 5 Too-rapid outflow rate of the dialysate solution

17. What is significant about the development of proteinuria in a client with type 1 diabetes mellitus?
1. Renal failure will develop in approximately 10 years.
2. It indicates that the client’s diabetes is uncontrolled.
3. Serum creatinine will diminish as albuminuria increases.
4. Insulin maintenance dose should be lowered.

18. A client with acute renal failure develops severe hyperkalemia. What would the nurse anticipate to be used to treat this imbalance?
1. Furosemide (Lasix)
2. Amphojel (aluminum hydroxide)
3. 50% glucose and regular insulin
4. Epoetin (Procrit)

Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.