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 20-25% of total cardiac output with a renal blood flow rate of 600-1300 mL/min.

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 120-140 mL/min).
      b. Changes in GFR occur when the pressure gradi-

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ENTS 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.

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 re-absorbed 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.

3. Tubular secretion: regulates the potassium level and maintains the acid-base balance with other regulatory mechanisms.
C. Urinary tract (Figure 18-1).

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.

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. Determine smoking history: cigarette smoking is a risk factor for bladder cancer.
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 18-1 and Table 18-1).
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).
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.

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

Data Collection

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. Ureterovesical reflux: the reflux of urine from the urethra into the bladder; this causes a constant residual of urine in the bladder after voiding and precipitates UTI.

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.

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

<table>
<thead>
<tr>
<th>TABLE 18-1</th>
<th>TYPES OF URINARY INCONTINENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE OF URINARY INCONTINENCE (UI)</td>
<td>DEFINITION</td>
</tr>
<tr>
<td>Urge</td>
<td>Involuntary loss of urine associated with a strong sensation of urinary urgency.</td>
</tr>
<tr>
<td>Stress</td>
<td>Involuntary loss of urine, usually associated with increased intra-abdominal pressure.</td>
</tr>
<tr>
<td>Mixed</td>
<td>Combination of urge and stress UI.</td>
</tr>
<tr>
<td>Overflow</td>
<td>Bladder overdistention.</td>
</tr>
<tr>
<td>Functional</td>
<td>Chronic impairment of physical and/or cognitive functioning.</td>
</tr>
<tr>
<td>Unconscious or reflex</td>
<td>Neurologic dysfunction secondary to nerve damage.</td>
</tr>
</tbody>
</table>

3. Vesicoureteral reflux (ureterovesical reflux): the reflux of urine from the bladder into one or both of the ureters and possibly into the renal pelvis.
4. Instrumentation: catheterization or cystoscopic examination.
5. Stasis of urine in the bladder leading to urinary retention for any reason (clients with prostate disease).
7. Bladder hypotonia: mechanical compression of the ureters; hormone changes predispose pregnant and postmenopausal women to more frequent UTIs.
8. Metabolic disorders such as diabetes.
9. Sexual intercourse promotes development of UTI.
10. Fecal contamination of the urethral meatus.

**TEST 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) (Figure 18-2).
   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 18-2).
3. Urosepsis: a urinary tract infection that has become systemic and is life-threatening.

**C. Diagnostics (see Appendix 18-I).**

**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 18-2).**
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.

**FIGURE 18-2 Urinary tract infection.** (From Zerwekh J, Claborn J, Miller CJ: Memory notebook of nursing, vol 1, ed 4, Ingram, 2008, Nursing Education Consultants.)

**BOX 18-2 OLDER ADULT CARE FOCUS**

**Urinary Tract Infection**

- First symptom may be increased confusion.
- A sudden onset of incontinence or an increase in frequency of incontinence should be investigated.
- A client with fever, chills, and tachycardia in the absence of urinary tract symptoms should be evaluated for septicemia from a urinary tract origin.
- Avoid use of indwelling urinary catheters.
- Encourage clients to void every 2 hours even if they do not feel a need; decreases residual urine and incontinence.
- Cleanse perineal area after each voiding and prevent fecal contamination of the urinary meatus.
- Women should wear cotton underwear and avoid tight, restrictive clothing.
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.
  - 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.

**Data Collection**

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

**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. Medications to increase urinary flow: tamsulosin (Flomax).
  4. Spasmolytic agents (anticholinergics).
  5. For uric acid stones, allopurinol (Zyloprim).
  6. Opioids for pain relief.
  7. 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 tend 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 hydromorphone (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

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

Data Collection

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 the end of the penis.
   4. Hypospadias is associated with cryptorchidism in severe cases.
   5. Bladder extrophy 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**: 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 extrophy).

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.

Data Collection
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 18-1).
1. Decreased serum protein levels: hypoalbuminemia.
2. Urinalysis: increased specific gravity, massive proteinuria (greater than 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.

Data Collection

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.
   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 peri orbital 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 18-1): 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.

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.
   4. Children with normal blood pressure, adequate urine output, and mild symptoms are cared for at home.
   5. 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.
   3. Hematuria, pallor, anorexia, weight loss, and malaise occur as condition progresses.
   4. Hypertension (63%).
C. Diagnostics (see Appendix 18-1).

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.
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 prerenal 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 1-3 weeks; the longer it lasts, the less favorable the recovery.
   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 2-6 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.

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 2-6 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.

**Data Collection**

**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. Dysrhythmias 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 18-1).**

**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.

**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.
CHAPTER 18  Urinary-Renal System

C. Dialysis (see Box 18-3): 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.
  - G. Support involved body systems.
    - 1. Cardiac dysrhythmias.
    - 2. Pulmonary function.
  - H. Avoid nephrotoxic medications, including NSAIDs.
  - **Goal:** To maintain nutrition.
    - A. Maintain dietary restrictions on sodium, potassium, and protein.
    - B. Encourage intake of carbohydrates and fats for energy source. Caloric needs are 30 to 35 kcal/kg.
    - C. Offer small frequent feedings; limit fluids.
    - D. Total parenteral or enteral nutrition may be necessary to promote healing if caloric intake cannot be maintained.

**Box 18-3  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.

**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.
  - A. End-stage renal failure (uremia).
    - 1. Severe azotemia.
      - a. Hyperkalemia, hypernatremia, and hyperphosphatemia.
      - b. Metabolic acidosis.
    - 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. 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, hypoproteinemia, carbohydrate intolerance.
8. Neurologic system: general central nervous system depression and peripheral neuropathy, headaches, seizures, sleep disturbances.
10. Integumentary system: yellow/gray discoloration, pruritus, uremic frost, ecchymosis.
11. Psychologic changes: emotional lability, with withdrawal, depression, and psychosis, personality and behavioral changes.

Data Collection

A. Risk factors/etiology.
1. Chronic hypertension and poorly controlled diabetes.
2. Chronic glomerulonephritis and pyelonephritis.
B. Diagnostics (see Appendix 18-1).
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 11-4).
3. Diuretics: thiazide and loop diuretics may be used early in the course of disease.
4. Erythropoietin (Epogen, Procrit) or 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. Fluid restriction: 600 to 1000 mL, adjusted according to urinary output and/or dialysis.
4. Sodium and potassium restriction: based on laboratory values.
C. Dialysis (see Box 18-3).
D. Surgical: kidney transplantation—the primary limiting factor in the number of transplantations done is the availability of kidneys.

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.

- **NURSING PRIORITY:** 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.
G. Assess client for bleeding tendencies. 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).
**Data Collection**

A. Types of transplant rejection.
   1. Hyperacute: not common.
      a. Occurs within minutes to hours after transplant.
      b. No treatment; transplanted kidney removed.
   2. Acute rejection.
      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.
      a. Occurs over months or years and is due to gradual occlusion of the renal blood vessels. 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 - immunosuppressive therapy and corticosteroids.

**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. Immunosuppressant drugs: may be started prior to surgery.
  C. 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.
  B. Assess for renal graft function.
     2. **Report to RN any sudden decrease or change in urine output.**
  C. Monitor for rejection symptoms.
  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).
  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.

**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. 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.

B. Types of dialysis (Box 18-3). 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.
     - **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.
     1. 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.
     2. Check the tubing for patency and keep drainage bag below the level of the abdomen.
     3. Turn client from side to side or put client in semi-Fowler’s position to increase abdominal pressure.
  B. Hemodialysis.
     - **NURSING PRIORITY:** 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. Report immediately any decrease of absence of pulsations or indications of decreased blood flow through the vascular access site.
     **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. The most common areas of metastasis are the liver, lungs, and bone, especially the mediastinum.

Data Collection

A. Clinical manifestations.
1. Palpable abdominal mass.
3. Weight loss, weakness, anemia, hypertension.
B. Diagnostics (see Appendix 18-1).

Treatment

A. Medical.
1. Palliative radiation therapy.
2. Biologic therapy with alpha interferon and interleukin-2.

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.

Study Questions: Urinary-Renal System

1. A female client is diagnosed with recurrent cystitis and is asking for information about self-care. What practice would the nurse discourage?
   1. Drink as much fluid as possible throughout the day.
   2. Take a shower rather than bathing in a tub.
   3. Refrain from voiding to reduce the concentration of the urine.
   4. Immediately void and wash after intercourse.

2. What finding would be noted on an assessment of a client who has an acute lower urinary tract infection?
   1. Gross painless hematuria.
   2. Low back pain.
   3. Polyuria.
   4. Dysuria.

3. At 10 am the nurse begins a 24-hour urine collection. What are the guidelines for collection of this specimen?
   1. Collect a specimen now, add it to the container, and collect all urine until 10 am the next day.
   2. Ask client to void now and discard the specimen; then collect all urine for 24 hours, ask client to void at 10 am the next day, and add to specimen container.
   3. Collect specimen now and discard it; then collect urine for 24 hours, ask client to void at 10 am the following morning, and discard specimen.
   4. Ask client to void now and discard specimen; then collect all urine for next 24 hours at 2-hour intervals and save in sterile containers.

4. The nurse is caring for a group of clients in a long-term care facility. What nursing measure will promote continence?
   1. Plan schedule to facilitate assisting everyone to the bathroom every 2 to 3 hours.
   2. Decrease the amount of PO fluids to increase bladder control.
   3. Record all clients’ intake and output to evaluate adequacy of intake.
   4. Assess for bladder distention in clients who are increasingly restless.

5. A client has a shunt in his left arm for dialysis. How will the nurse check the patency of the shunt?
   1. Palpate above the forearm for a rushing sound.
   2. Check the pulse site distal to the shunt.
   3. Palpate the shunt site for presence of a thrill.
   4. Check the shunt site for warmth and color.

6. An infant is born with hypospadias. The mother asks the nurse when circumcision should be done. What is the best nursing response?
   1. There is no problem with circumcision; it can be done whenever the parents desire it.
   2. Circumcision will probably be delayed until there can be further diagnostic studies of the problem.
   3. Circumcision is most often done when the congenital condition is repaired.
   4. Voiding studies will have to be completed before circumcision can be done.
7. Kidney transplant clients are frequently placed on immunosuppressant drugs. What nursing measure would not be appropriate in caring for these clients?
1. Keep all irrigation fluids sterile.
2. Maintain aseptic technique.
3. Give all medications by injection.
4. Screen all visitors for infections.

8. The nurse is caring for a client in renal failure. What observations would indicate the development of a complication of uremia in this client?
1. Anorexia, nausea, and vomiting.
2. Pneumonia and respiratory depression.
3. Tachycardia and stupor.
4. Restlessness and diuresis.

9. Which client would be at the highest risk for the development of acute renal failure?
1. Client with placenta previa with hemorrhage controlled.
2. Client with cardiac disease and frequent problems of tachycardia.
3. Hypertensive client who forgets to take his medication.
4. Older adult client with a 20-year history of type II diabetes.

10. Why is it important for the nurse to monitor the red blood cell count in a chronic renal failure client?
1. Granulocytopenia could occur, which can cause infection.
2. Production of erythropoietin will be affected due to renal failure.
3. Blood cell production could increase due to the increased production of renin.
4. An increase in waste products could cause thrombocytopenia.

11. A client has had a kidney stone removed by nephrolithotomy. A nephrostomy tube has been placed in the right kidney. What would be important nursing care for this client?
1. Clamp the nephrostomy tube and drain every 2 hours.
2. Irrigate the nephrostomy tube with 30 mL normal saline to maintain patency.
3. Remove the tube at approximately 1 inch every hour.
4. Maintain the drainage collection dependent to the client’s position.

12. What is the best description of the pain that a client experiences when beginning to pass a renal calculus?
1. Intermittent sharp pain that radiates down the left leg.
2. Intermittent dull but hot pain in the upper thighs.
3. Dull flank pain that only occurs with voiding.
4. Sharp pain in the shoulder and chest that radiates.

13. When providing instructions to geriatric clients on the prevention of urinary tract infections, what would the nurse instruct the clients to avoid?
1. Taking any medications containing acetaminophen.
2. Increasing fluid intake to 3000mL daily.
3. Cleansing the perineal area from back to front.
4. Increasing intake of fruit juices.

14. A cystoscopy is going to be performed on a client. What is important for the nurse to tell the client?
1. A local anesthetic and a sedative will be given; if he is awake during the procedure, he should not experience severe pain.
2. A sedative will be given, but it is important for him to remain fully awake in order to cooperate with the physician during the procedure.
3. A long black tube will be inserted through the wall of the bladder for 15 minutes to view the bladder wall and interior.
4. A three-way Foley will be inserted, and dye will be injected into the urinary tract through the cystoscope.

15. What would the nurse anticipate finding when performing a skin assessment on a chronic renal failure client?
1. Warm, moist, pink-colored skin.
2. Cool, clammy, dusky-colored skin.
3. Warm, edematous, copper-colored skin.

16. The nurse is caring for a client in acute renal failure. What nursing observations would indicate the development of a complication associated with the problem of fluid volume excess in this client?
1. Decreased sensation and tingling in the extremities.
2. Increased incidence of bleeding gums and epistaxis.
3. Increasing peripheral edema and moist breath sounds.
4. Serum potassium above 4 mEq/L.

17. The nurse is assessing a client in acute renal failure. What is an indication the client is progressing into the oliguric stage?
1. Hematuria of 600 mL/24 hours.
2. Increasing urine specific gravity.
3. Serum potassium level of 3.5 mEq/L.
4. Urine output of 400 mL/24 hours.

18. A female client is being catheterized. The nurse advances the catheter into an opening 5 to 6 inches with no urine return. What is the best interpretation of this situation?
1. The catheter is too small for urine to flow without pressure.
2. There must be a defect in the catheter.
3. The client was catheterized after she had voided.
4. The catheter is not in the urinary meatus and is probably in the vagina.

Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.
# Appendix 18-1 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.</td>
</tr>
<tr>
<td>Calcium level</td>
<td>9-11 mg/dL</td>
<td>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.</td>
</tr>
<tr>
<td>Urinalysis</td>
<td></td>
<td>Obtain first-voided specimen in the morning. Presence of protein, WBC, RBC, glucose, bacteria, and hyaline casts indicate problems. Dipstick urinalysis is initially performed to determine levels of nitrites and leukocyte esterase related to infections.</td>
</tr>
<tr>
<td>Urine culture and sensitivity</td>
<td></td>
<td>Colony count of at least 100,000 colonies/mL of urine indicates infection.</td>
</tr>
<tr>
<td>Urine specific gravity</td>
<td>Adults: 1.003-1.030</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>
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</table>

## Laboratory Diagnostics

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Clinical and Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KUB x-ray exam:</strong> A flat plate x-ray film of the abdomen and pelvis.</td>
<td>Bowel preparation may or may not be indicated.</td>
</tr>
</tbody>
</table>
| **Intravenous urography (IVP or excretory urogram):** IV injection of radiopaque dye to visualize the urinary tract system. | 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 (hypersensitivity) 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. |
| **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. | 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. |
### Appendix 18-1  DIAGNOSTICS OF THE URINARY-RENAL SYSTEM —cont’d.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Clinical and Nursing Implications</th>
</tr>
</thead>
</table>
| **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. | 1. No specific activity or dietary restrictions.  
2. Explain procedure to client. |
| **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. | 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. |
| **Bladder scan:** A portable ultrasound scanner used to estimate residual urine in the bladder. | 1. No specific preparation.  
2. After client voids, apply gel to the suprapubic area, and use scanner to visualize bladder and possible retained urine.  
3. 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. |
| **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. | 1. Assess and evaluate for UTI after procedure.  
2. Tests are often indicated for clients having difficulty with urinary control (e.g., those with spinal cord traumatic injuries, stroke, etc.). |
| **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. |                                                                                                   |
| **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. | 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. |
| **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. | 1. Encourage fluids, as test requires a full bladder.  
2. Placed 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.
### 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 5-10 for sulfonamide medications for UTI.

### Medications Side Effects Nursing Implications

<table>
<thead>
<tr>
<th>Medications</th>
<th>Side Effects</th>
<th>Nursing Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urinary Tract Antiseptics:</strong></td>
<td></td>
<td>1. Requires adequate renal function to concentrate medication in urine.</td>
</tr>
<tr>
<td>Nitrofurantoin (Furadantin, Macrodantin, APO-Nitrofurantoin, Nitrofan): PO, IM</td>
<td>GI upset, blood dyscrasia, pulmonary reactions</td>
<td></td>
</tr>
<tr>
<td><strong>Urinary Analgesics:</strong></td>
<td></td>
<td>1. Contraindicated in renal and liver dysfunction.</td>
</tr>
<tr>
<td>Phenazopyridine hydrochloride (AZO-Standard, Pyridium, Urodine, Urogesic): PO Available OTC</td>
<td>Headache, GI disturbances</td>
<td>2. Advise client to report any yellow discoloration of skin or eyes.</td>
</tr>
<tr>
<td><strong>Bladder Relaxants:</strong></td>
<td></td>
<td>3. Urine will turn orange.</td>
</tr>
<tr>
<td>Oxybutynin (Ditropan, Ditropan XL): PO, transdermal</td>
<td>Drowsiness, dizziness, weakness, blurred vision, dry mouth, constipation Fatigue, headache, dry mouth, dry eyes, constipation</td>
<td>4. Administer with caution in clients with impaired renal function.</td>
</tr>
<tr>
<td><strong>Glycoprotein Hormones:</strong></td>
<td></td>
<td>1. Grapefruit juice can increase blood levels.</td>
</tr>
<tr>
<td>Epoetin alfa (Epogen, Procrit): IV, subQ</td>
<td>Hypertension, thromboembolic problems, headaches, GI disturbances</td>
<td>2. Caution client to avoid use of alcohol or OTC antihistamines.</td>
</tr>
</tbody>
</table>

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

### Medications

<table>
<thead>
<tr>
<th>Immunosuppressive Medications: Inhibit the immunologic response.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Azathioprine</strong> <em>(Imuran)</em>: PO, IV</td>
</tr>
<tr>
<td>Dose- and duration-dependent.</td>
</tr>
<tr>
<td>Bone marrow suppression: leukopenia, thrombocytopenia, anemia.</td>
</tr>
<tr>
<td>Nausea, vomiting, anorexia.</td>
</tr>
<tr>
<td>Alopecia, rash.</td>
</tr>
<tr>
<td>1. Interacts with allopurinol, causing an increase in <em>Imuran</em> toxicity.</td>
</tr>
<tr>
<td>2. Avoid use in pregnancy.</td>
</tr>
<tr>
<td>3. Take with food or milk to decrease GI upset.</td>
</tr>
<tr>
<td>4. Should not be given to client with active infection.</td>
</tr>
<tr>
<td>5. Follow-up CBCs should be done at least monthly while client is taking medication.</td>
</tr>
<tr>
<td>6. Closely monitor client for development of infections.</td>
</tr>
<tr>
<td><strong>Cyclosporine</strong> <em>(Sandimmune, Neoral)</em>: PO, IV</td>
</tr>
<tr>
<td>Dose- and duration-dependent</td>
</tr>
<tr>
<td>Infections, nephrotoxicity, hepatotoxicity, hypertension, hirsutism, gum hyperplasia, tremors.</td>
</tr>
<tr>
<td>1. Monitor renal function because nephrotoxicity occurs frequently.</td>
</tr>
<tr>
<td>2. Avoid use in pregnancy.</td>
</tr>
<tr>
<td>3. Use the pipette supplied by manufacturer to measure dose; mix with 4-8 oz. of water, milk, or juice.</td>
</tr>
<tr>
<td>4. Evaluate blood pressure and report elevations (especially occurs with heart transplants).</td>
</tr>
<tr>
<td>5. Monitor liver function studies.</td>
</tr>
<tr>
<td>6. Good oral hygiene should be practiced to reduce gum problems.</td>
</tr>
<tr>
<td>7. Teach client that he/she should not stop taking the medication or change dosage without physician’s order.</td>
</tr>
<tr>
<td>8. Serum blood levels are monitored at regular intervals.</td>
</tr>
<tr>
<td>9. Hirsutism that occurs is reversible.</td>
</tr>
<tr>
<td><strong>Antilymphocyte globulin</strong> <em>(ALG)</em>: IV</td>
</tr>
<tr>
<td>Fever, chills, tachycardia, hypotension, bronchospasm.</td>
</tr>
<tr>
<td>1. More than 50% of clients experience a fever.</td>
</tr>
<tr>
<td>2. Have epinephrine and supportive emergency care available, because an allergic reaction can occur at any time during therapy.</td>
</tr>
<tr>
<td>3. Administer slowly over 4-6 hr.</td>
</tr>
<tr>
<td>4. Client may be premedicated with acetaminophen, diphenhydramine HCl, or methylprednisolone.</td>
</tr>
</tbody>
</table>

**Methylprednisolone sodium succinate** *(Solu-Medrol)*: IV

- See Appendix 5-7

**Tacrolimus** *(Prograf, FK506)*: PO
- Hepatotoxicity, nephrotoxicity, neurotoxicity, hyperglycemia, seizures, hypertension, GI effects.
- 1. Monitor blood pressure closely.
- 2. Increases risk for infection.

**Mycophenolate mofetil** *(CellCept)*: PO, IV
- Leukopenia, thrombocytopenia, GI (diarrhea, nausea, vomiting), UTI, hypertension, peripheral edema.
- 1. Usually used in combination with other medications.
- 2. Give on an empty stomach.

*CBCs*, Complete blood counts; *GI*, gastrointestinal; *IL-2*, interleukin 2; *IV*, intravenous; *PO*, by mouth (orally); *RA*, rheumatoid arthritis; *UTI*, urinary tract infection.
URINARY DIVERSION

A urinary diversion is a means of diverting urinary output from the bladder to an external device or via a new avenue.

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.

**Nursing Implications**
1. Check frequently for placement of ureteral catheters; tension should be avoided.
2. Ureteral catheter should not be clamped or irrigated.
3. Maintain accurate intake and output records and label all catheters.

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.
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. 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 PCP 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.

FIGURE 18-3 Urinary Diversions. (From Potter P, Perry A: Fundamentals of nursing, ed 7, St Louis, 2008, Mosby.)
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.

TEST ALERT: Collection of urine specimens is a common nursing action; be sure to know why the sample is being obtained and the nursing management.
KEY POINTS: Insertion of a Retention Catheter

- A sterile procedure.
- Lubricate catheter with sterile lubricant provided in tray.
- 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.

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.

**TEST ALERT:** Insert a urinary catheter.
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 inserted:
   • 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.