Chapter 30
Genitourinary/Renal Disorders

Lesson 30.1
Renal Failure and Dialysis
Learning Objectives

• Label a diagram of the urinary system.
• Distinguish between acute and chronic renal failure.
• Outline the pathophysiology of renal failure.

Learning Objectives

• Identify the signs and symptoms of renal failure.
• Describe the process of hemodialysis and peritoneal dialysis.
• Describe the signs and symptoms and care of emergent conditions associated with dialysis.

Anatomy and Physiology Review

• Genitourinary system
  – Refers to two different body systems
  – Genito refers to genital organs and reproductive system
    • Responsible for perpetuation of our species
    • Comprised of male and female reproductive organs
  – Urinary refers to
    • Removal of metabolic waste products from blood
    • Removal of concentrated urine
    • Conservation of water
Anatomy and Physiology Review

- Genitourinary system plays primary role in
  - Regulating water and electrolytes
  - Regulating acid-base
  - Excreting waste products and foreign chemicals
  - Regulating arterial blood pressure
  - Producing red blood cells
  - Stimulating glucose production
Anatomy and Physiology Review

- Contents of urinary system
  - Two kidneys
  - Two ureters
  - Urinary bladder
  - Urethra
- Renal structures refer to kidneys and their related structures
Renal Disease

• Kidneys
  – Two bean-shaped organs about size of person’s fist
  – Lie on posterior abdominal wall behind peritoneum
  – Superior border of kidney reaches level of 12th thoracic vertebrae
  – Inferior border lies just above horizontal plane of umbilicus, typically level with 3rd lumbar vertebrae

Renal Disease

• Kidneys
  – Inferior border is one finger breadth superior to iliac crest
  – Center of kidney, where ureter is attached, is level with intervertebral disc between first and second lumbar vertebrae
  – Superior pole of each kidney is protected by rib cage

Renal Disease

• Nephron
  – Basic functional unit of kidney
  – Millions inside each kidney
  – Filters blood
  – Removes waste products
  – Produces urine
  – Damage to nephrons results in renal (kidney) disease
Renal Disease

- Causes can be classified as prerenal, intrarenal, and postrenal
  - Prerenal disease
    - Occurs before kidney is reached
    - Characterized by inadequate blood flow (perfusion) to kidneys
  - Intrarenal disease (intrinsic disease)
    - Disease or damage within kidney
  - Postrenal disease
    - Diseases that block system that collects urine
    - All can result in acute or chronic renal failure, leading to end-stage renal disease
    - Classification depends on duration of renal failure and on potential for reversibility

Why might the patient develop the complications just described (of uremia)?
Acute Renal Failure

- ARF, also known as acute kidney injury (AKI)
- Clinical syndrome that results from sudden and significant decrease in filtration through glomeruli
  - Leads to buildup of high levels of uremic toxins in blood
  - Acute renal failure occurs when kidneys are unable to excrete daily load of toxins in urine

Acute Renal Failure

- Patients with ARF are separated into two groups based on amount of urine excreted in 24 hours
  - Oliguric
    - Excrete less than 500 mL/day
  - Nonoliguric
    - Excrete more than 500 mL/day

Acute Renal Failure

- Can threaten life of patient
  - It carries 40 to 50 percent mortality rate for those who are hospitalized for disease
- If recognized early and treated appropriately, may be readily reversible
Acute Renal Failure

• Causes
  – Trauma
  – Shock
  – Infection
  – Urinary obstruction
  – Multisystem diseases

• Onset of ARF can occur within hours
  – As normal kidney function rapidly deteriorates, urine output frequently decreases (oliguria) or stops completely (anuria)
  • Results in uremia
  • Uremia is excess of urea and other nitrogenous wastes in blood
  • Generally results from kidney malfunction

• Uremia may be associated with
  – Generalized edema from water and salt retention
  – Acidosis from failure of kidneys to rid body of normal acidic products
  – High concentrations of nonprotein nitrogens (especially urea) from failure of body to secrete metabolic end products
Acute Renal Failure

- Uremia may be associated with
  - High concentrations of other products of renal excretion (such as uric acid and potassium)
  - Must be recognized early and treated appropriately
    - If not, renal dysfunction leads to development of heart failure, volume overload, hyperkalemia, metabolic acidosis

Prerenal Acute Renal Failure

- Results from inadequate perfusion of kidneys
  - Damaged kidneys are unable to rid blood of waste products such as urea and creatinine
  - May be caused by hypovolemia or impaired cardiac output
  - Obstruction of renal arteries results in decreased blood flow to kidneys
    - Causes an increase in renal vascular resistance that effectively shunts blood away from kidneys

Prerenal Acute Renal Failure

- Many patients with prerenal ARF are critically ill
  - Have number of preexisting medical conditions such as atherosclerosis, chronic liver disease, and heart failure
  - Dehydration caused by diuretic use in patients with heart failure is major cause of prerenal ARF
  - Perfusion often is poor within many organs
    - May lead to multiple organ failure
Prerenal Acute Renal Failure

• Signs and symptoms
  – Dizziness
  – Dry mouth
  – Thirst
  – Hypotension
  – Tachycardia
  – Weight loss

Prerenal Acute Renal Failure

• Treatment goal
  – Improve kidney perfusion and function by treating underlying condition
  – Fluids administered intravenously to most patients to treat dehydration
  – After this, urine output generally increases and renal function improves

Intrarenal Acute Renal Failure

• Also known as intrinsic ARF
• Results from conditions that damage or injure both kidneys
  – Examples
    • Glomerular and other microvascular diseases
    • Tubular diseases
    • Interstitial diseases that cause direct damage to kidney parenchyma
Intrarenal Acute Renal Failure

• Nearly 90 percent of all cases are caused by ischemia or toxins
  – Can lead to acute tubular necrosis (death of tubular cells)
  – Ischemic causes of intrarenal ARF are associated with renal hypoperfusion

Intrarenal Acute Renal Failure

• Occur most often from hemorrhage, trauma, sepsis, and in patients undergoing cardiovascular surgery
• Nephrotoxic causes occur most often in elderly and in patients with chronic renal failure

Intrarenal Acute Renal Failure

• Drugs and other compounds that can trigger intrarenal ARF
  – Antibiotics
  – Nonsteroidal anti-inflammatory drugs
  – Anticancer drugs
  – Radiocontrast dyes
  – Alcohol and other drug use (e.g., cocaine)
• Condition associated with hypertension, autoimmune diseases (e.g., systemic lupus), and pyelonephritis
### Intrarenal Acute Renal Failure

- **Signs and symptoms**
  - Fever
  - Flank pain
  - Joint pain
  - Headache
  - Hypertension
  - Confusion
  - Seizure
  - Oliguria

- **Treatment goal:** restore adequate renal blood flow
  - Resolve underlying cause and its complications
  - In severe cases, renal dialysis or kidney transplant may be needed to manage the disease

### Postrenal Acute Renal Failure

- **Caused by obstruction to urine flow from both kidneys**
  - May be caused by ureteral and urethral obstructions (bilateral calculi, prostatic enlargement, urethral strictures)
  - Result from obstruction of urinary catheter
    - Blockage of urine causes pressure to build in renal nephrons and ultimately can cause nephrons to shut down
    - Degree of renal failure corresponds directly with degree of obstruction
Postrenal Acute Renal Failure

• Signs and symptoms
  – Urine retention
  – Distended bladder
  – Gross hematuria
  – Pain in lower back, abdomen, groin, or genitalia
  – Peripheral edema
• Reversible by removing obstruction to urine flow

Chronic Renal Failure

• Progressive, irreversible systemic disease
  – Develops over months to years as internal structures of kidney are slowly damaged
  – As renal function steadily declines, leads to end-stage renal disease that will eventually require dialysis or kidney transplant
  – May be caused by congenital disorders or prolonged pyelonephritis
  – In industrialized world, more often results from systemic diseases such as diabetes and hypertension and from autoimmune disorders

Chronic Renal Failure

• Kidneys try to make up for renal damage by hyperfiltration within remaining working nephrons
  – Over time, hyperfiltration causes further nephron damage and loss of kidney function
  – Chronic loss of function causes generalized wasting and progressive scarring within all parts of kidney
  – Damage results in reduction in nephron mass and renal mass
Chronic Renal Failure

- Results in buildup of fluid and waste products in body
- Causes azotemia (retention of excessive amounts of nitrogenous compounds in blood) and uremia

Chronic Renal Failure

- Complications
  - Hypertension
  - Congestive heart failure
  - Anemia
  - Electrolyte abnormalities

Chronic Renal Failure

- Once diagnosed and cause identified, treatments are started to delay or possibly stop progressive loss of kidney function
  - In its final stages, often requires treatment with dialysis (hemodialysis or peritoneal dialysis) or kidney transplant for patient to survive
Chronic Renal Failure

• Six systemic manifestations
  – Gastrointestinal manifestations
    • Anorexia
    • Nausea
    • Vomiting
    • Metallic taste in the mouth

• Six systemic manifestations
  – Cardiopulmonary manifestations
    • Hypertension
    • Pericarditis
    • Pulmonary edema
    • Peripheral, sacral, and periorbital edema
    • Myocardial ischemia

• Six systemic manifestations
  – Nervous system manifestations
    • Anxiety
    • Delirium
    • Progressive obtundation
    • Hallucinations
    • Muscle twitching
    • Neuropathies of the hands and feet
    • Tremors or seizures
Chronic Renal Failure

• Six systemic manifestations
  – Metabolic or endocrine manifestations
    • Glucose intolerance
    • Electrolyte disturbances
    • Anemia

• Six systemic manifestations
  – Personality changes
    • Fatigue
    • Mental dullness
    • Confusion
  – Signs of uremia
    • Pasty, yellow skin discoloration and thin extremities from protein wasting
    • Uremic frost caused by urea crystals that form on skin (late finding)
Renal Dialysis

• Technique used to normalize blood chemistry and remove excess fluid in patients with acute or chronic renal failure
• Removes blood toxins in some patients who have taken drug overdose

Renal Dialysis

• Two types
  – Hemodialysis
  – Peritoneal dialysis
  – Both bring patient’s blood into contact with semipermeable membrane across which water-soluble substances diffuse into dialyzing fluid (dialysate)
  – Eventually electrolytes are balanced between patient’s blood and dialysis fluid and waste products are eliminated

Renal Dialysis

• Amount of substance that transfers during dialysis depends on
  – Difference in concentrations of solutions on two sides of semipermeable membrane
  – Molecular size of substance
  – Length of time blood and dialysate remain in contact with membrane
  – In patients with end-stage renal disease, usually is performed three times/week
    • Each session may last 4 to 5 hours
Hemodialysis

- Patient’s heparinized blood is pumped through surgically constructed
  - Arteriovenous fistula
    - Internal anastomosis between artery and vein
  - Arteriovenous graft
    - Synthetic material grafted between patient’s artery and vein
  - Usually located in inner aspect of patient’s forearm
  - Less often, may be located in upper arm or medial aspect of lower extremity

Peritoneal Dialysis

- Dialysis membrane is patient’s own peritoneum
  - Dialysate is infused into peritoneal cavity by temporary or permanently implanted catheter
  - Fluid and solutes diffuse from blood in peritoneal capillaries into dialysate
    - After 1 to 2 hours, equilibration has occurred
    - Dialysate is then drained and fresh fluid is infused
  - Works much more slowly than hemodialysis
    - Over time, just as effective
Peritoneal Dialysis

- Does not require chronic blood access
- Major complication: peritonitis
  - Usually results when proper aseptic technique is not used
- May be carried out regularly in home by patient or by family caregiver

Dialysis Emergencies

- Example
  - Patient may experience problems associated with
    - Vascular access
    - Hemorrhage
    - Hypotension
    - Chest pain
    - Severe hyperkalemia
    - Disequilibrium syndrome
    - Development of air embolism
**Dialysis Emergencies**

- Be aware of problems that may result from concurrent medical illness and its treatment
  - Examples
    - Include decreased ability to tolerate stress of significant illness or trauma
    - Inadvertent over-administration of IV fluid
    - Altered metabolism and unpredictable action of drugs

**Vascular Access Problems**

- Problems
  - Bleeding at site of puncture for dialysis
  - Thrombosis
  - Infection
- Bleeding from fistula or graft usually is minimal
  - Can be controlled by direct pressure at site
    - Excessive pressure can cause thrombosis in graft or fistula

**Vascular Access Problems**

- Rare but potential complication of internal shunt is development of pseudoaneurysm
  - Condition that resembles aneurysm that occurs at site of graft
  - Can rupture and may cause large hematoma and possible hypovolemic
    - If occurs, apply direct pressure to hematoma and assess and treat patient for significant blood loss
    - Requires rapid transport
Vascular Access Problems

• Fistulae and grafts that become occluded as result of thrombus formation usually require
  – Surgical intervention
  – Administration of thrombolytic agent to restore flow
• Patients with surgical anastomosis are instructed to check for presence of bruit or “thrill” periodically
  – Presence will verify unobstructed circulation

Vascular Access Problems

• Attempts to clear graft by irrigation or aspiration are not advised
• If thrombosis occurs while patient is undergoing dialysis, dialysis should be stopped
  – Intravenously administered fluids should be initiated in alternative site
  – Decreased blood flow is common trigger of thrombosis
  • Main reason that one should not take blood pressure in arm with vascular access

Vascular Access Problems

• Infection at site of vascular access usually is result of puncture made during dialysis
  – Careful sterile technique is rule when caring for these patients
  – Routine vascular access using dialysis route is discouraged
  – Vascular access infection should be considered when dialysis patient has unexplained fever, malaise, or other signs of systemic infection
Hemorrhage

- Patients receiving dialysis have increased risk of hemorrhage
  - Arises from their regular exposure to anticoagulants during hemodialysis and from decrease in their platelet function
  - Patient with hemorrhage from trauma or medical condition (e.g., gastrointestinal bleeding) should be monitored closely for signs of hypovolemia

Hemorrhage

- Most patients on dialysis have anemia related to decrease in production of erythropoietin
  - Lowers their ability to compensate for blood loss when they have acute hemorrhage
  - Any significant blood loss (whether external or internal) may produce dyspnea or angina
  - If hemorrhage from trauma occurs in extremity with fistula or graft, control bleeding and immobilize extremity
  - Special care must be taken to avoid obstructing circulation in anastomosis

Hypotension

- Can occur with hemodialysis
  - May result from
    - Rapid reduction in intravascular volume
    - Abrupt changes in electrolyte concentrations
    - Vascular instability that may occur during the procedure
  - Mechanisms to cope with these physiological changes may be impaired
    - May result in inability to maintain normal blood pressure
  - Patients with hypotension caused by dialysis must be managed cautiously with administration of volume-expanding fluids
Hypotension

- Be careful not to produce fluid overload
  - May manifest as hypertension and classic signs of congestive heart failure
  - Most patients respond to small (200- to 300-mL) fluid challenge
    - If they do not, other potentially serious causes should be considered

Chest Pain

- Episodes of hypotension and mild hypoxemia that occur during dialysis may result in myocardial ischemia (MI) and chest pain
  - May complain of other symptoms associated with decreased O₂ delivery
  - May indicate evolving MI
  - Often relieved with administration of O₂, fluid replacement, and antianginal medications
  - All patients with chest pain should be treated as though MI has occurred

Chest Pain

- Dysrhythmias that result from MI also may be associated with dialysis
  - Most common ischemic rhythm disturbances are premature ventricular contractions
  - If dialysis is in progress, procedure should be stopped
  - Consult with medical direction
Severe Hyperkalemia

- Emergency that poses serious threat to life
  - Can occur rapidly in patients with acute renal failure
  - Often results from poor dietary regulation and missed dialysis treatments
  - Patients with severe hyperkalemia may have weakness but are often asymptomatic
  - Typical ECG changes seen with hyperkalemia initially demonstrate tall or tented T wave

Severe Hyperkalemia

- As potassium levels rise, conduction slows
  - Results in prolonged P-R interval, depressed ST segments, and sometimes loss of P waves
  - May be followed by widened QRS complex and delayed conduction in interventricular conducting system
  - ECG patterns resemble bundle branch blocks
- Disturbances may not become apparent until dangerous levels of potassium are present

<table>
<thead>
<tr>
<th>QRS complex</th>
<th>Approximate serum K⁺ (mEq/L)</th>
<th>ECG change</th>
</tr>
</thead>
<tbody>
<tr>
<td>P wave T wave</td>
<td>4</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>6-7</td>
<td>Peaked T wave</td>
</tr>
<tr>
<td></td>
<td>7-8</td>
<td>Flattened P wave, prolonged PR interval, depressed ST segment, peaked T wave</td>
</tr>
<tr>
<td></td>
<td>8-9</td>
<td>Arrhythmia, prolonged QRS duration, further peaked T waves</td>
</tr>
<tr>
<td></td>
<td>&gt;9</td>
<td>Sine-wave pattern</td>
</tr>
</tbody>
</table>
Severe Hyperkalemia

- Any patient with renal failure who is in cardiac arrest should be suspected of having severe hyperkalemia
  - Based on patient history, medical direction may recommend separate administration of calcium and sodium bicarbonate during resuscitation
  - High-dose nebulized albuterol to decrease plasma potassium concentration has also been reported to be effective

Disequilibrium Syndrome

- Group of neurological findings that sometimes occur during or immediately after dialysis
  - Symptoms are usually mild
    - Headache
    - Restlessness
    - Nausea
    - Fatigue

- Symptoms may be severe
  - Confusion
  - Seizures
  - Coma
Disequilibrium Syndrome

- Result from disproportionate decrease in osmolality of extracellular fluid compared with that of intracellular compartment in brain or cerebrospinal fluid
  - Results in osmotic gradient between blood and brain
    - Causes movement of water into brain, then cerebral edema and increased intracranial pressure
    - If seizures occur, anticonvulsant may be indicated

Air Embolism

- Negative pressure on venous side of dialysis tubing or malfunction in machine can allow an air embolism to enter patient’s bloodstream
  - Rare occurrence
  - If occurs, embolus may be carried to right ventricle of heart
  - In heart embolus may block passage of blood to left myocardium

Air Embolism

- Signs and symptoms
  - Severe dyspnea
  - Cyanosis
  - Hypotension
  - Respiratory distress
Air Embolism

- Treatment
  - Requires high-concentration O₂ administration
  - Rapid transport
  - Position patient on left side
    - Traps embolism where it will be least likely to obstruct blood flow
  - Transport in modified Trendelenburg’s position

Which of these complications could cause an immediate life threat?

Renal Failure Management

- Prehospital management
  - Airway and ventilatory support with supplemental high-concentration O₂ administration
  - Vascular access for fluid replacement, medication therapy (diuretics, antidysrhythmics, vasopressors), or fluid resuscitation if needed
  - Meticulous aseptic technique during IV access
  - ECG and other vital sign monitoring
  - Rapid transport to appropriate medical facility
Lesson 30.2
Genitourinary and Renal Disorders

Learning Objective

• Describe the pathophysiology, signs and symptoms, assessment, and prehospital management of the patient with urinary retention, urinary tract infection, pyelonephritis, urinary calculus, epididymitis, Fournier’s gangrene, phimosis, paraphimosis, priapism, benign prostatic hypertrophy, testicular masses, and testicular torsion.

Learning Objectives

• Outline the physical examination for patients with genitourinary disorders.
• Discuss general prehospital management for the patient with a genitourinary disorder.
Urinary System Conditions

- Urinary system disorders that may cause acute pain
  - Urinary retention
  - Urinary tract infection (cystitis, urethritis)
  - Pyelonephritis
  - Renal calculi
- May produce visceral, somatic, and referred pain

Urinary Retention

- Inability to urinate
  - Possible causes
    - Urethral stricture
    - Enlarged prostate (benign or malignant prostatic hypertrophy)
    - CNS dysfunction
    - Foreign body obstruction
    - Use of certain drugs such as parasympatholytic or anticholinergic agents
  - Men are affected more often than women
    - Most commonly due to enlarged prostate

Urinary Retention

- Signs and symptoms
  - Severe abdominal pain associated with urgent need to urinate
  - Distended bladder
    - Often is palpable
Urinary Retention

• Patients with progressive obstruction often have history of
  – Urinary hesitancy
  – Poor urine stream
  – Sense of incomplete emptying of bladder
  – Nocturia (excessive urination at night)
  – Overflow incontinence (overflow of urine from bladder)

Urinary Retention

• May also cause delirium, especially in elderly patients
• In emergency department, passage of urethral catheter to empty bladder often required
  – Urinary retention is painful for patient
• Prehospital care mainly is supportive
  – If abdominal pain is present, IV line to keep vein open may be indicated

Urinary Retention

• Cause of retention should be sought, and if not easily correctable following physician examination, patient may require hospitalization
• Some EMS systems may permit urinary catheterization in prehospital setting to empty patient’s bladder
Have you ever been in a situation where you needed to urinate very urgently but could not because of the circumstances? How did you feel?

Urinary Tract Infection

- Account for 7 to 8 million physician office visits each year and 100,000 hospitalizations
  - Secondary only to respiratory tract infections as problem seen by physicians
  - Usually develop first in lower urinary tract (urethra or bladder)
  - If not treated, can progress to upper urinary tract (ureters or kidneys)

Urinary Tract Infection

- Account for 7 to 8 million physician office visits each year and 100,000 hospitalizations
  - Upper tract infections often associated with kidney infection (pyelonephritis) or abscesses that form within kidney tissue
    - Can lead to reduced kidney function
    - Can lead to death in untreated
Urinary Tract Infection

- UTI of urethra (urethritis) and bladder (cystitis) occurs when enteric flora (particularly *Escherichia coli* normally found in bowel) enter opening of urethra and colonize urinary tract
- More common in women because urethra is short and close to vagina and rectum
- Occurs in men (as a result of urethritis, prostatitis, and cystitis) and children

Urinary Tract Infection

- Urethritis and prostatitis in young men most often results from venereal disease rather than true UTI
  - Other factors that contribute to lower UTI
    - Use of contraceptive devices (women who use diaphragm develop infections more often; condoms with spermicidal foam may cause growth of *E. coli* in the vagina, which may enter urethra)
    - Unsafe sexual practices
    - Presence of renal stones
    - Bladder catheterization

Urinary Tract Infection

- Urethritis and prostatitis in young men most often results from venereal disease rather than true UTI
  - Other factors that contribute to lower UTI
    - Suppressed immune system
    - *Chlamydia trachomatis* or *Mycoplasma hominis* can transmit bacteria to their partner during sexual intercourse
    - These bacteria then could cause UTI
Urinary Tract Infection

• Signs and symptoms
  – Painful or difficult urination (dysuria)
  – Urinary frequency
  – Hematuria
  – Cloudy or rust-colored urine (sometimes with unusual or foul odor)
  – Flank or suprapubic abdominal pain
  – Often patient will reveal history of UTI episodes
  – Fever, chills, and malaise may be present

• Diagnosis confirmed in hospital through urinalysis and microscopic examination for blood cells, sediment, and bacteria
• Generally treated with antibiotic therapy

Pyelonephritis

• Inflammation of kidney parenchyma (upper urinary tract)
  – Most often occurs as result of lower UTI
  – Associated with bacterial infection, particularly in presence of occasional or persistent backflow (reflux) of infected urine from bladder into ureters or kidney pelvis
  – Bacterial infections may also be carried to one or both kidneys
  – May be carried through bloodstream or lymph glands from infection that began in bladder
Pyelonephritis

• More common in adult women
• Can affect persons of any age and either sex
• Acute episodes can be severe in elderly and immunosuppressed

Pyelonephritis

• Onset of signs and symptoms is usually abrupt
  – Patients often mistake pain of pyelonephritis for lower back strain
  – May be complicated by systemic infection with signs and symptoms that include
    • Fever
    • Chills
    • Flank pain
    • Cloudy or bloody urine
    • Nausea
    • Vomiting

Pyelonephritis

• Left untreated, can progress to chronic condition that can last for months or years
  – May lead to scarring and possible loss of kidney function
• Therapeutic intervention consists primarily of antibiotics, fluid replacement, and sometimes hospitalization
How will you examine the patient for flank pain?

Urinary Calculus

- Urinary calculi (kidney stones)
  - Pathological concretions that originate in renal pelvis
  - Most painful and most common disorders of urinary tract
    - About 250,000 hospitalizations each year
    - 77 percent of men and 3 percent of women in U.S. will have kidney stone at some point in their lives
  - Result from supersaturation of urine with insoluble salts

Urinary Calculus

- When level of insoluble salts or uric acid in urine is high, urine lacks citrate (chemical that normally inhibits formation of stones)
- If insufficient water in kidneys to dissolve waste products, kidney stones can form
- Most common in men ages 20 to 50
- Recurrent, more common in men than women
Urinary Calculus

- Associated risk factors
  - Dehydration
  - CNS disorders (absent sensory/motor impulses from injury or disease)
  - Drug use (anesthetics, opiates, psychotropic agents, some herbal medicines)
  - Surgery (postoperative complication)

Urinary Calculus

- Chemical composition of kidney stones depends on chemical imbalance in urine
  - Four most common types of stones are composed of calcium, uric acid, struvite, and cystine
  - Calcium stones
    - Calcium compounds chemically bound to oxalate (most common) or phosphate
    - Account for about 85 percent of all kidney stones
    - Typically occur in patients with metabolic (e.g., gout) or hormonal disorders (e.g., hyperparathyroidism)

Urinary Calculus

- Uric acid stones
  - Account for about 10% of kidney stones
  - Formation is more common in men
  - May have heritable component
Urinary Calculus

• Struvite stones
  – Also known as infection stones
  – More common in women
  – Often are linked to chronic bacterial UTI or frequent bladder catheterization
• Cystine stones
  – Least common and result from rare congenital condition in which there are large amounts of cystine (an amino acid) in urine
  – Difficult to treat and may require lifelong therapy

Urinary Calculus

• Signs and symptoms vary according to location
  – Most stones obstruct ureter at points of ureteral narrowing in their passage from kidneys to bladder
  – Produces acute, excruciating pain
    • Originates in the flank area and radiates to right or left lower abdominal quadrant, groin, and testes (in male patients)
  – Renal or ureteral colic produces severe cyclical pain
    • Pain occurs as ureter tries to use forceful contractions to push stone into bladder
    • Pain often described as same intensity as labor pain

Urinary Calculus

• Pain may be accompanied by
  – Restlessness
  – Nausea and vomiting
  – Urinary urgency or frequency
  – Diaphoresis
  – Low-grade fever
  – Hematuria
  – Dysuria
  – Increased BP (because of pain)
Urinary Calculus

• Prehospital care may include
  – IV fluids
  – Transport in position of comfort
  – Antiemetics
  – Pain management (nitrous oxide, ketorolac, narcotic analgesics)

Urinary Calculus

• Physician care may include
  – Analgesics (anesthetics, opiates, psychotropics)
  – Fluid replacement
  – Antiemetics
  – Possible hospital admission
  – If calculus does not pass spontaneously, surgical intervention may be required

Have you cared for or known someone who had a urinary calculus? How did that person describe the pain? What was their level of discomfort?
Male Genital Tract Conditions

• Some related to disease
• Others result from trauma
• Include
  – Epididymitis
  – Fournier’s gangrene
  – Various structural conditions (phimosis, priapism, benign prostatic hypertrophy, testicular masses, and testicular torsion)

Epididymitis

• Inflammation of epididymis
  – Epididymis
    • Tubular section of male reproductive system
    • Carries sperm from testicle to seminal vesicles
  – Often caused by bacterial infection associated with other structures of genitourinary tract
    • Tends to occur in sexually active young men
  – Most common type of epididymitis in young men results from venereal disease
  – In men older than 35, urinary tract pathogens are most cause

Epididymitis

• Signs and symptoms
  – Gradual onset of unilateral scrotal pain
    • Radiates to spermatic cord
  – Tender swelling of scrotum and testicle
    • Produces inflammation of one or both testes (orchitis)
  – Patient may have recent history of UTI, fever, and malaise
  – Urethral discharge may be present
Epididymitis

- After physician evaluation, therapeutic intervention includes
  - Antibiotics
  - Bed rest
  - Analgesics
  - Elevation of scrotum

Fournier’s Gangrene

- Bacterial infection of skin that affects genitals and perineum (in both men and women)
  - Urological emergency that results after wound or abrasion becomes infected
  - Combination of microorganisms (e.g., staphylococcal) and fungi (e.g., yeast) causes infection to spread
  - Can lead to necrosis of skin, subcutaneous tissue, and muscle
  - Can be fatal if infection enters bloodstream, causing sepsis, shock, and organ failure

Fournier’s Gangrene

- Men are 10 times more likely to develop disease
- Men 60 to 80 years old with predisposing conditions are most susceptible
  - Predisposing factors
    - Alcoholism
    - IV drug use
    - Genital piercing
    - Obesity
    - Diabetes
    - Leukemia
    - Immune system disorders
Fournier’s Gangrene

- Can develop as complication of surgery
- Hallmarks of disease are intense pain and tenderness in genitalia

Fournier’s Gangrene

- Depending on stage of disease, assessment findings in genital area may include
  - Crepitus of skin
  - Gray-black coloration from decay (gangrene)
  - Drainage of pus
  - Fever
Fournier’s Gangrene

• Usually progresses through five stages
  – Prodromal symptoms of fever and lethargy, may be present for 2 to 7 days
  – Intense genital pain and tenderness usually associated with edema of overlying skin
  – Increasing genital pain and tenderness with progressive erythema of overlying skin
  – Dusky appearance of overlying skin; subcutaneous crepitation
  – Obvious gangrene of portion of genitalia; purulent drainage from wounds

• Prehospital care
  – Emotional support
  – Rapid transport
  – Possible full resuscitation measures to manage shock
  – Following stabilization, physician care will include various methods to restore normal organ perfusion and function
    • Methods may include antibiotic therapy, hyperbaric oxygen therapy, and surgery (including reconstruction)

Phimosis

• Tightness of prepuce (foreskin) of penis of uncircumcised male
  – Prevents retraction of foreskin over glans
  – Can be caused by failure of foreskin to loosen during growth, infection, genital disease, and trauma
  – Usually painless condition
  – Infection can result from ineffective cleaning of penis, which can cause swelling, redness, and discharge
  – Rarely, patient may complain of problems with urination or intercourse
Phimosis

- **Paraphimosis**
  - Inability of uncircumcised male pull retracted foreskin back over head of penis
  - Can restrict blood flow and requires emergency care
  - Hallmark sign is “doughnut” of swollen skin around shaft, near head of penis
  - Occurs most often in children and elderly
  - If left untreated, can disrupt blood flow to tip of penis

Phimosis

- **Paraphimosis**
  - In severe cases, can lead to damage of penis tip, gangrene, and loss of penis tip
  - Emergency care may include
    - Gentle compression of head of penis while pushing foreskin forward
    - Wrapping penis in plastic and applying ice to reduce swelling, allowing foreskin to return to its extended position
    - If this fails, patient may require hospitalization and surgical circumcision
Priapism

- Persistent, usually painful, erection that lasts for 4 or more hours and occurs without sexual stimulation
  - Condition develops when blood in penis becomes trapped and unable to drain
  - If not treated immediately, can lead to scarring and permanent erectile dysfunction
  - Can occur in all age groups, including newborns
  - Usually affects male children between 5 and 10 years of age, men between 20 and 50 years of age

Priapism

- Two categories of priapism: low-flow and high-flow
  - Low-flow priapism
    - Results from blood being trapped in erection chambers of penis
    - Often occurs for unknown reason in men who are otherwise healthy
    - Affects men with sickle-cell disease, leukemia and other cancers, or malaria

Priapism

- Two categories of priapism: low-flow and high-flow
  - High-flow priapism
    - Less common than low-flow priapism and is usually less painful
    - Results from ruptured artery from injury to penis or perineum
    - Rupture prevents blood in penis from circulating normally
Priapism

- Can be caused by some medications
  - Antidepressants (e.g., Desyrel)
  - Antipsychotics (e.g., Thorazine)
  - Injection drugs to treat erectile dysfunction (ED)
  - Oral ED drugs (e.g., Viagra)

Priapism

- Other causes
  - Trauma to spinal cord or to genital area
  - Black widow spider bites
  - CO₂ poisoning
  - Illicit drug use (e.g., marijuana and cocaine)
- Prehospital care
  - Primarily supportive
  - Transport

Benign Prostatic Hypertrophy

- Enlargement of prostate gland
  - Male organ that produces prostatic fluid, component of semen
  - Sits beneath bladder and surrounds urethra
  - Most men have period of prostate growth in their mid-to late 40s when cells in central portion of gland reproduce rapidly
  - As tissues in area enlarge, often compress urethra and may partially block flow of urine
Benign Prostatic Hypertrophy

- Not all men are symptomatic
- Complaints
  - Urinary frequency
  - Weak urine stream
  - Difficulty starting and stopping urination
  - Overflow incontinence
  - Hematuria
  - Urinary tract infection

Benign Prostatic Hypertrophy

- Treatment
  - Depends on severity of signs and symptoms and how they affect daily life
  - Medications
  - Surgery
  - Nonsurgical therapies

Testicular Masses

- Enlargement or growth on one or both testicles
  - Most are benign, but some may be malignant
  - Most common benign masses
    - Hydrocele
    - Spermatocele
    - Varicocele
Testicular Masses

- **Hydrocele**
  - Fluid-filled sack along spermatic cord within scrotum
- **Spermatocele**
  - Benign cystic accumulation of sperm that arises from head of epididymis
  - Both conditions result in collections of fluid in scrotal sac
    - Masses are generally soft and painless
    - Size can rapidly change as fluid enters or leaves scrotum

Testicular Masses

- **Varicocele**
  - Enlargement of veins that drain testicles
  - Masses are soft, scrotal swellings that are often more prominent while standing or exercising
  - May sometimes cause sensation of heaviness, or a dull ache in genital area

Testicular Masses

- Diagnosed using ultrasound and transillumination techniques
- Most require no treatment
- If hydrocele or spermatocele is large and/or painful, surgery may be needed to drain fluid
- Varicocele may require surgery to tie off affected veins
Testicular Masses

• Testicular cancer may also present as testicular mass, with or without pain
  – Usually feels firm and arises from testicle
  – Diagnosis made using blood tests and scrotal ultrasound
  – Treatment involves surgery to remove affected testicle, chemotherapy, and/or radiation

Testicular Torsion

• True urological emergency
  – Testicle (usually left) twists on its spermatic cord
    • Disrupts blood supply of testicle
  – May result from blunt trauma to scrotal area
  – More often is spontaneous
  – Two peak periods in which torsion is likely to occur are first year of life and at puberty, with range in age from 5 months to 41 years, and average of 14 years
Testicular Torsion

- Results in tender epididymis and painful swelling of scrotal sac
- Patient usually is afebrile
  - Pain is sudden in onset and usually severe
  - Often preceded by vigorous physical activity or athletic event

Testicular Torsion

- Pain
  - Sometimes radiates to ipsilateral left quadrant
  - Unrelieved by rest or scrotal elevation
  - Often is associated with nausea and vomiting
- Must be diagnosed and treated within 6 hours to prevent loss of testis from ischemic infarction
Testicular Torsion

• Therapeutic intervention
  – Application of ice packs to scrotum
  – Manual manipulation by physician to reduce torsion
  – Patient must undergo surgical repair within 4 to 6 hours of onset
  – Rapid transport critical

Physical Examination

• Assessment of abdomen and genitalia of either sex can be awkward and uncomfortable for patient and paramedic
  – Protect patient’s privacy with proper drapes to ensure privacy
  – When possible, paramedics of same sex as patient should perform examinations
  – If not possible, chaperone should be present
  – Proceed with calm, caring, and competent attitude
  – Patient and significant others should be informed of all actions

Physical Examination

• Exam includes
  – Primary assessment
  – Focused history
    • OPQRST (Onset/origin, Provokes, Quality, Region, Severity, Time)
    • Previous history of similar event
    • Nausea or vomiting
    • Change in bowel habits or stool (constipation, diarrhea)
    • Change in urinary voiding pattern
    • Weight loss
    • Last oral intake
    • Last bowel movement
Physical Examination

- Exam includes
  - Physical examination
    - Appearance
    - Posture
    - Level of consciousness
    - Apparent state of health
    - Skin color
    - Vital signs
    - Abdominal examination (inspection, auscultation, percussion, palpation)
    - Genitalia examination (if indicated)

Management and Treatment Plan

- Manage patients with genitourinary disorders as any other patient with acute pain
  - Includes
    - Providing airway, ventilatory, and circulatory support
    - Administering high-concentration O₂ (if indicated)
    - ECG and vital sign monitoring
    - Rapid, gentle transportation for physician evaluation in patient’s position of comfort

Management and Treatment Plan

- Manage patients with genitourinary disorders as any other patient with acute pain
  - Patients should not be permitted to eat or drink because surgery may be indicated
  - All patients who have had persistent genitourinary pain or discomfort for several hours should be transported for physician evaluation
Summary

• The urinary system removes waste products from blood
  – Helps to maintain a constant body fluid volume and composition
• Nephron is functional unit of kidney
  – Filters blood, removes waste products, and produces urine

Summary

• Renal failure may result in uremia, hyperkalemia, acidosis, hypertension, and volume overload with congestive heart failure
• Acute renal failure (ARF) occurs when kidneys are unable to excrete daily load of toxins in urine
  – Its onset may be within hours

Summary

• Prerenal ARF results from poor perfusion of kidneys
  – Intrarenal ARF is caused by conditions that damage tissues of the kidney
  – Postrenal ARF is caused by obstruction of urine flow from both kidneys
Summary

• Dialysis is technique used to normalize blood chemistry
  – Used in patients who have acute or chronic renal failure
  – Used to remove blood toxins
  – Two dialysis techniques are hemodialysis and peritoneal dialysis
  – Dialysis emergencies may include problems with vascular access, hemorrhage, hypotension, chest pain, severe hyperkalemia, disequilibrium syndrome, air embolism, or cardiac arrest

Summary

• Urinary retention is inability to urinate
• Urinary tract infections can involve upper or lower urinary tract
• Pyelonephritis is inflammation of kidney parenchyma and can lead to chronic renal problems

Summary

• Urinary calculi are stones that originate in kidney
• Epididymitis is inflammation of epididymis
  – Epididymis is tube that carries sperm from testicle to seminal vesicles
• Fournier’s gangrene is bacterial infection of genitals that can lead to death of skin tissue and systemic sepsis
Summary

• Phimosis is tightness of foreskin of penis
  – Paraphimosis occurs when an uncircumcised male is unable to retract foreskin over head of penis
• Priapism is painful, sustained erection
• Benign prostatic hypertrophy is enlargement of prostate gland
  – May be associated with urinary difficulty and urinary tract infections

Summary

• Testicular masses may be benign or cancerous
• Testicular torsion is a true emergency
  – Testicle twists on its spermatic cord
  – Disrupts blood supply to testicle

Summary

• The physical examination for a patient with a urinary tract problem is similar to that performed for abdominal pain
  – Patients with genitourinary pain should be managed as any other patient with acute pain
Questions?