chapter 8

# Cephalosporins

## Key Terms

*aplastic anemia*
*epidermal necrolysis*
*nephrotoxicity*
*Stevens-Johnson syndrome*

## Chapter Objectives

*On completion of this chapter, the student will:*

- Explain the difference between the first-, second-, and third-generation cephalosporins.
- Discuss uses, general drug action, adverse reactions, contraindications, precautions, and interactions associated with the cephalosporins.
- Discuss important preadministration and ongoing assessment activities the nurse should perform on the patient taking cephalosporins.
- List some nursing diagnoses particular to a patient taking cephalosporins.
- Discuss ways to promote an optimal response to therapy, how to manage common adverse reactions, special considerations related to administration, and important points to keep in mind when educating patients about the use of the cephalosporins.

The effectiveness of penicillin in the treatment of infections prompted research directed toward finding new antibiotics with a wider range of antibacterial activity. The cephalosporins are a valuable group of drugs that are effective in the treatment of almost all of the strains of bacteria affected by the penicillins, as well as some strains of bacteria that have become resistant to penicillin. The cephalosporins are structurally and chemically related to penicillin.

The cephalosporins are divided into first-, second-, and third-generation drugs. Particular cephalosporins also may be differentiated within each group according to the microorganisms that are sensitive to them. Generally, progression from the first-generation to the second-generation and then to the third-generation drugs shows an increase in the sensitivity of gram-negative microorganisms and a decrease in the sensitivity of gram-positive microorganisms. For example, a first-generation cephalosporin would have more use against gram-positive microorganisms than would a third-generation cephalosporin. This scheme of classification is becoming less clearly defined as newer drugs are introduced. Examples of first-, second-, and third-generation cephalosporins are listed in Display 8-1. For a more complete listing see the Summary Drug Table: Cephalosporins.

## ACTIONS

Cephalosporins affect the bacterial cell wall, making it defective and unstable. This action is similar to the action of penicillin. The cephalosporins are usually bactericidal (capable of destroying bacteria).

## USES

The cephalosporins are used in the treatment of infections caused by susceptible microorganisms. Examples of microorganisms that may be susceptible to the cephalosporins include streptococci, staphylococci,

**DISPLAY 8-1 ● Examples of First-, Second-, and Third-Generation Cephalosporins**

First generation—cephalexin (Keflex), cefazolin (Ancef), cephapirin (Cefadyl)
Second generation—cefaclor (Ceclor), cefoxitin (Mefoxin), cefuroxime (Zinacef)
Third generation—cefoperazone (Cefobid), cefotaxime (Claforan), ceftriaxone (Rocephin)

## SUMMARY DRUG TABLE CEPHALOSPORINS

| GENERIC NAME | TRADE NAME* | USES | ADVERSE REACTIONS | DOSAGE RANGES |
|---|---|---|---|---|
| ***First-Generation Cephalosporins*** | | | | |
| cefadroxil<br>*saf-a-drox´-ill* | Duricef | Infections due to susceptible microorganisms | Nausea, vomiting, diarrhea, hypersensitivity reactions, superinfection, nephrotoxicity, headache, Stevens-Johnson syndrome, pseudomembranous colitis | 1–2 g/d PO in divided doses |
| cefazolin sodium<br>*sef-a'-zoe-lin* | Ancef, Kefzol, *generic* | Infections due to susceptible microorganisms; perioperative prophylaxis | Nausea, vomiting, diarrhea, hypersensitivity reactions, superinfection, nephrotoxicity, headache, Stevens-Johnson syndrome, pseudomembranous colitis | 250 mg–1 g IM, IV 6–12h; perioperative, 0.5–1g IM, IV |
| cephalexin<br>*sef'-a-lex-in* | Keflex, *generic* | Infections due to susceptible microorganisms | Same as cefadroxil | 1–4 g/d PO in divided doses |
| ***Second-Generation Cephalosporins*** | | | | |
| cefaclor<br>*sef´-a-klor* | Ceclor | Treatment of infections due to susceptible organisms | Nausea, vomiting, diarrhea, hypersensitivity reactions, nephrotoxicity, headache, hematologic reactions | 250 mg PO q8h |
| cefamandole<br>*sef-a-man'-dole* | Mandol | Same as cefaclor | Same as cefaclor | 500 mg to 1 g IM, IV q4–6h |
| cefotetan<br>*sef-oh-tee'-tan* | Cefotan | Same as cefaclor; perioperative prophylaxis | Same as cefaclor | 1–6 g IM, IV in equally divided doses; perioperative: 1–2 g IV |
| cefoxitin<br>*sef-ox´-i-tin* | Mefoxin | Same as cefaclor; perioperative prophylaxis | Same as cefaclor | 1–2 g IM q6–8h; 1–12 g/d IV in equally divided doses; perioperative, 1–2 g IV |
| cefpodoxime<br>*sef-poed-ox'-eem* | Vantin | Same as cefaclor | Same as cefaclor | 200–800 mg/d PO in equally divided doses |
| cefprozil<br>*sef-proe'-zil* | Cefzil | Same as cefaclor | Same as cefaclor | 250–500 mg PO q12h |
| cefuroxime<br>*sef-yoor-ox'-eem* | Ceftin, Kefurox, Zinacef | Same as cefaclor; perioperative prophylaxis | Same as cefaclor | 250 mg PO BID; 750 mg–1.5 g IM or IV g8h; perioperative, 1.5 g IV |
| loracarbef<br>*lor-ah-kar'-bef* | Lorabid | Same as cefaclor | Same as cefaclor | 200–400 mg PO q12h |
| ***Third-Generation Cephalosporins*** | | | | |
| cefdinir<br>*sef'-din-er* | Omnicef | Same as cefaclor | Same as cefaclor | 300 mg PO q12h or 600 mg q24h PO |
| cefepime hydrochloride<br>*sef'-ah-pime* | Maxipime | Same as cefaclor | Same as cefaclor | 0.5 mg–2 g IV, IM q12h |
| cefixime<br>*sef-ix'-eem* | Suprax | Same as cefaclor | Same as cefaclor | 400 mg/d as a single dose or divided doses |

## SUMMARY DRUG TABLE CEPHALOSPORINS (*Continued*)

| GENERIC NAME | TRADE NAME* | USES | ADVERSE REACTIONS | DOSAGE RANGES |
|---|---|---|---|---|
| cefoperazone *sef-oh-per'-a-zone* | Cefobid | Same as cefaclor | Same as cefaclor | 2–4 g/d IM, IV in equally divided doses |
| cefotaxime *sef-oh-taks'-eem* | Claforan | Same as cefaclor; perioperative prophylaxis | Same as cefaclor | 2–8 g/d IM or IV in equally divided doses q6–8h; maximum 12 g/d |
| ceftazidime *sef-taz'-i-deem* | Frotaz, Tazidime, Ceptaz | Same as cefaclor | Same as cefaclor | 250 mg–2 g IV, IM q8-12h |
| ceftibuten hydrochloride *sef-ta-byoo'-ten* | Cedax | Same as cefaclor | Same as cefaclor | 400 mg/d for 10 days |
| ceftizoxime *sef-ti-zox'-eem* | Cefizox | Same as cefaclor | Same as cefaclor | 1–2 g (range, 1–4 g) IM or IV q8–12h; maximum, 12 g/d |
| ceftriaxone *sef-try-ax'-on* | Rocephin | Same as cefaclor; perioperative prophylaxis; gonorrhea | Same as cefaclor | 1–2 g/d IM, IV QID, BID; maximum, 4 g/d; perioperative, 1 g IV; gonorrhea, 250 mg IM as a single dose |

*The term *generic* indicates the drug is available in generic form.

citrobacters, gonococci, shigella, and clostridia. Culture and sensitivity tests (see Chap. 7) are performed whenever possible to determine which antibiotic, including a cephalosporin, will best control an infection caused by a specific strain of bacteria. Pharyngitis, tonsillitis, otitis media, lower respiratory infections, urinary tract infections, septicemia, and gonorrhea are examples of the types of infections that may be treated with the cephalosporins.

The cephalosporins also may be used perioperatively, that is, during the preoperative, intraoperative, and postoperative periods, to prevent infection in patients having surgery on a contaminated or potentially contaminated area, such as the gastrointestinal tract or vagina. In some instances, a specific drug may be recommended for postoperative prophylactic use only.

## ADVERSE REACTIONS

The most common adverse reactions seen with administration of the cephalosporins are gastrointestinal disturbances, such as nausea, vomiting, and diarrhea.

Hypersensitivity (allergic) reactions may occur with administration of the cephalosporins and range from mild to life threatening. Mild hypersensitivity reactions include pruritus, urticaria, and skin rashes. More serious hypersensitivity reactions include **Stevens-Johnson syndrome** (fever, cough, muscular aches and pains, headache, and the appearance of lesions on the skin, mucous membranes, and eyes), hepatic and renal dysfunction, **aplastic anemia** (anemia due to deficient red blood cell production), and **epidermal necrolysis** (death of the epidermal layer of the skin).

Because of the close relation of the cephalosporins to penicillin, a patient allergic to penicillin also may be allergic to the cephalosporins.

Other adverse reactions that may be seen with administration of the cephalosporins are headache, dizziness, **nephrotoxicity** (damage to the kidneys by a toxic substance), malaise, heartburn, and fever. Intramuscular (IM) administration often results in pain, tenderness, and inflammation at the injection site. Intravenous (IV) administration has resulted in thrombophlebitis and phlebitis.

Therapy with cephalosporins may result in a bacterial or fungal superinfection. Diarrhea may be an indication of pseudomembranous colitis, which is one type of bacterial superinfection. See Chapter 7 for a discussion of bacterial and fungal superinfections and pseudomembranous colitis.

## CONTRAINDICATIONS

The nurse should not administer cephalosporins if the patient has a history of allergies to cephalosporins or penicillins.

## PRECAUTIONS

The nurse should use cephalosporins cautiously in patients with renal or hepatic impairment and in patients with bleeding disorders. Safety of cephalosporin administration has not been established in pregnancy or lactation; these drugs are assigned to Pregnancy Category B.

## INTERACTIONS

The risk of nephrotoxicity increases when the cephalosporins are administered with the aminoglycosides (see Chap. 10). The risk for bleeding increases when the cephalosporins are taken with oral anticoagulants. A disulfiram-like reaction may occur if alcohol is consumed within 72 hours after cephalosporin administration. Symptoms of a disulfiram-like reactions include flushing, throbbing in the head and neck, respiratory difficulty, vomiting, sweating, chest pain, and hypotension. Severe reactions may cause arrhythmias and unconsciousness. When the cephalosporins are administered with the aminoglycosides, the risk for nephrotoxicity increases.

## NURSING PROCESS

### The Patient Receiving a Cephalosporin

### ASSESSMENT

As with most drugs, assessment depends on the drug, the patient, and the reason for administration.

#### *Preadministration Assessment*

Before the administration of the first dose of a cephalosporin, it is important to obtain a general health history. The health history includes an allergy history, a history of all medical and surgical treatments, a drug history, and the current symptoms of the infection. If the patient has a history of allergy, particularly a drug allergy, the nurse explores this area to ensure that the patient is not allergic to a cephalosporin. Patients with a history of an allergy to penicillin may also be allergic to a cephalosporin (see Chap. 7) even though they have never received one of these drugs. If an allergy to either of these drug groups is suspected, the nurse informs the primary health care provider of this before the first dose of the drug is given. Liver and kidney function tests may be ordered by the primary health care provider. The nurse should check to be sure any cultures for sensitivity testing are done before the first dose of the drug is administered.

#### *Ongoing Assessment*

An ongoing assessment is important in evaluating the patient's response to therapy, such as a decrease in temperature, the relief of symptoms caused by the infection (eg, pain or discomfort), an increase in appetite, and a change in the appearance or amount of drainage (when originally present). The nurse notifies the primary health care provider if symptoms of the infection appear to worsen. The nurse checks the patient's skin regularly for rash and is alert for any loose stools or diarrhea.

### NURSING DIAGNOSES

Drug-specific nursing diagnoses are highlighted in the Nursing Diagnoses Checklist. Other, more general nursing diagnoses are discussed in Chapter 4.

### PLANNING

The expected outcomes for the patient depend on the reason for administration but may include an optimal response to therapy (infectious process controlled), management of adverse drug reactions, and an understanding of and compliance with the prescribed treatment regimen.

### IMPLEMENTATION

#### *Promoting an Optimal Response to Therapy*

The nurse must question the patient about allergy to cephalosporins or the penicillins before administering the first dose, even when an accurate drug history has been taken. Information regarding a drug allergy may have been forgotten at the time the initial drug history was obtained. If a patient gives a history of possible cephalosporin or penicillin allergy, the nurse withholds the drug and contacts the primary health care provider.

ORAL ADMINISTRATION. The nurse administers cephalosporins around the clock to the patient to provide adequate blood levels. Most cephalosporins may be taken with food to prevent gastric upset. Cefdinir may be taken without regard to food. The absorption of oral cefuroxime and cefpodoxime is increased when given with food. However, if the patient experiences gastrointestinal upset, the nurse can administer the drug with

**Nursing Diagnoses Checklist**

- ✓ **Risk for Imbalanced Body Temperature: Hyperthermia** related to infection
- ✓ **Diarrhea** related to superinfection secondary to cephalosporin therapy
- ✓ **Risk for Impaired Skin Integrity** related to adverse reactions secondary to cephalosporin therapy

food. The nurse should shake oral suspensions well before administering them.

Some cephalosporins are available as powder for a suspension and are reconstituted by a pharmacist or a nurse. It is important to keep this form of the drug refrigerated until it is used.

PARENTERAL ADMINISTRATION. The nurse should read the manufacturer's package insert for each drug for instructions regarding reconstitution of powder for injection, storage of unused portions, life of the drug after it is reconstituted, methods of IV administration, and precautions to be taken when the drug is administered.

Some cephalosporins are given by direct IV, intermittent infusion, or continuous IV infusion. When the direct IV method is used, the nurse gives the dose directly into a vein. Intermittent IV infusion is given by means of Y tubing while another solution is being given on a continuous basis. When this method is used, the nurse clamps off IV fluid given on a continuous basis while the drug is allowed to infuse. Continuous IV infusion requires that the nurse add the drug to a specified amount of an IV solution at a drip rate or volume per hour prescribed by the primary health care provider.

**Nursing Alert**

*When the drug is given IV, the nurse inspects the needle insertion site for signs of extravasation or infiltration (see Chap. 2). In addition, it is important to inspect the needle insertion site and the area above the site several times a day for signs of redness, which may indicate thrombophlebitis (inflammation of a vein with formation of a clot within the vein) or phlebitis (inflammation of a vein). If either problem occurs, the nurse contacts the primary health care provider and the IV must be discontinued and restarted in another vein, preferably in another extremity.*

**Gerontologic Alert**

*When a cephalosporin is given IM, the nurse injects the drug into a large muscle mass, such as the gluteus muscle or lateral aspect of the thigh. It is important to rotate injection sites. The nurse warns the patient that at the time the drug is injected into the muscle, there may be a stinging or burning sensation and the area may be sore for a short time. The nurse informs the primary health care provider if previously used areas for injection appear red or if the patient reports continued pain in the area.*

### *Monitoring and Managing Adverse Reactions*

The nurse observes the patient closely for any adverse drug reactions, particularly signs and symptoms of a hypersensitivity reaction. It is important to report a rash or hives to the primary health care provider because this may be a precursor to a severe anaphylactic reaction (see Chap. 7). In severe cases, the primary health care provider may discontinue the cephalosporin therapy. The nurse closely observes the patient for signs and symptoms of a bacterial or fungal superinfection (see Chap. 7). If any occur, the nurse contacts the primary health care provider before the next dose of the drug is due.

Rare cases of hemolytic anemia, including fatalities, have been reported with the administration of the cephalosporins. The patient should be monitored for anemia. If a patient experiences anemia within 2 to 3 weeks after the start of cephalosporin therapy, drug-induced anemia should be considered. If hemolytic anemia is suspected, the primary health care provider will discontinue the drug therapy. The patient may require blood transfusions to correct the anemia. Frequent hematological studies may be required.

**Nursing Alert**

*Nephrotoxicity may occur with the administration of these drugs. Early signs of this adverse reaction may become apparent by a decrease in urine output. The nurse should measure and record the fluid intake and output and notify the primary health care provider if the output is less than 500 mL/d. Any changes in the fluid intake-and-output ratio or in the appearance of the urine may indicate nephrotoxicity. It is important that the nurse report these findings to the primary health care provider promptly.*

**Gerontologic Alert**

*The older adult is more susceptible to the nephrotoxic effects of the cephalosporins, particularly if renal function is already diminished because of age or disease. If renal impairment is present, a lower dosage and monitoring of blood creatinine levels are indicated. Blood creatinine levels greater than 4 mg/dL indicate serious renal impairment. In elderly patients with decreased renal function, a dosage adjustment may be necessary.*

FEVER. The nurse takes vital signs every 4 hours or as ordered by the primary health care provider. It is important to report any increase in temperature to the primary health care provider because additional treatment measures, such as administration of an antipyretic drug or change in the drug or dosage, may be necessary.

DIARRHEA. Frequent liquid stools may be an indication of a superinfection or pseudomembranous colitis. If pseudomembranous colitis occurs, it is usually seen 4 to 10 days after treatment is started.

The nurse inspects each bowel movement and immediately reports to the primary health care provider the occurrence of diarrhea or loose stools containing blood and mucus because it may be necessary to discontinue the drug use and institute treatment for diarrhea, a superinfection, or pseudomembranous colitis.

If there appears to be blood and mucus in the stool, the nurse saves a sample of the stool and tests for occult blood using a test such as Hemoccult. If the stool tests positive for blood, the sample is saved for possible laboratory testing for blood.

IMPAIRED SKIN INTEGRITY. The nurse inspects the skin every 4 hours for redness, rash, or lesions that appear as red wheals or blisters. When a skin rash or irritation is present, the nurse administers frequent skin care. Emollients, antipyretic creams, or a topical corticosteroid may be prescribed. An antihistamine may be prescribed. Harsh soaps and perfumed lotions are avoided. The nurse instructs the patient to avoid rubbing the area and not to wear rough or irritating clothing.

**Nursing Alert**

*The patient is at risk for Stevens-Johnson syndrome when taking the cephalosporins. Stevens-Johnson syndrome is manifested by fever, cough, muscular aches and pains, headache, and the appearance of lesions on the skin, mucous membranes, and eyes. The lesions appear as red wheals or blisters, often starting on the face, in the mouth, or on the lips, neck, and extremities. This syndrome, which also may occur with the administration of other types of drugs, can be fatal. The nurse should report any of these symptoms to the primary health care provider immediately.*

### *Educating the Patient and Family*

The nurse carefully reviews the dose regimen with the patient and family and teaches the patient the following information:

- Complete the full course of therapy. Do not stop the drug even if the symptoms have disappeared unless directed to do so by the primary health care provider.
- Take the drug at the prescribed times of day because it is important to keep an adequate amount of drug in the body throughout the entire 24 hours of each day.
- It is a good idea to take each dose with food or milk if gastrointestinal upset occurs after administration.
- Avoid drinking alcoholic beverages when taking the cephalosporins and for 3 days after completing the course of therapy because severe reactions may occur.
- Notify the primary health care provider immediately if any one or more of the following occurs: vomiting, skin rash, hives (urticaria), severe diarrhea, vaginal or anal itching, sores in the mouth, swelling around the mouth or eyes, breathing difficulty or gastrointestinal disturbances, such as nausea, vomiting, and diarrhea. Do not take the next dose of the drug until the problem is discussed with the primary health care provider (see Home Care Teaching Checklist: Teaching About Superinfection).
- Oral suspensions—keep the container refrigerated (if so labeled), shake the drug well before pouring (if so labeled), and return the drug to the refrigerator immediately after pouring the dose. Drugs that are kept refrigerated lose their potency when kept at room temperature. If a small amount of the drug is left after the last dose is taken, discard it because the drug (in suspension form) begins to lose potency after a few weeks.
- Never give this drug to another individual even though the symptoms appear to be the same.
- Notify the primary health care provider if the symptoms of the infection do not improve or if the condition becomes worse.

## EVALUATION

- Therapeutic effect is achieved; infection is controlled.
- Adverse reactions are identified, reported to the primary health care provider, and managed successfully with nursing interventions.
- Patient and family demonstrate understanding of the drug regimen.
- Patient verbalizes importance of complying with the prescribed therapeutic regimen.

## ● *Critical Thinking Exercises*

1. *Mr. Jonas is receiving a cephalosporin IM. He tells you that he has had to get out of bed several times this morning because he has diarrhea. Determine what questions you would ask Mr. Jonas. Analyze what steps you would take to resolve this problem.*
2. *A patient who is a recent immigrant to the United States is seen in the outpatient clinic for a severe upper respiratory infection. The primary health care provider prescribes a cephalosporin and asks you to give the patient instructions for taking the drug. You note that the patient appears to understand very little English. Discuss how you would solve this problem. Determine what information you would include in a teaching plan*

## Home Care Checklist

### TEACHING ABOUT SUPERINFECTION

Antibiotics are one of the most commonly administered types of drug therapy in the home. Any patient taking antibiotics, especially cephalosporins, is susceptible to superinfection. The nurse makes sure the patient knows the signs and symptoms of superinfection.

A bacterial superinfection commonly occurs in the bowel. The nurse teaches the patient to report any of the following:

- ☑ Diarrhea, possibly severe with visible blood and mucus
- ☑ Fever
- ☑ Abdominal cramps

A fungal superinfection commonly occurs in the mouth, vagina, and anogenital areas. The nurse teaches the patient to report any of the following:

- ☑ Scaly, reddened, papular rash commonly in the breast folds, at the axillae, groin, or umbilicus
- ☑ White or yellow vaginal discharge
- ☑ Localized redness, inflammation, and excoriation, particularly inside the mouth, in the groin, or skin folds of the anogenital area
- ☑ Anal or vaginal itching
- ☑ Creamy white lacelike patches on the tongue, mouth, or throat
- ☑ Burning sensation in the mouth or throat

*and how you would evaluate the effectiveness of the teaching plan for this patient.*

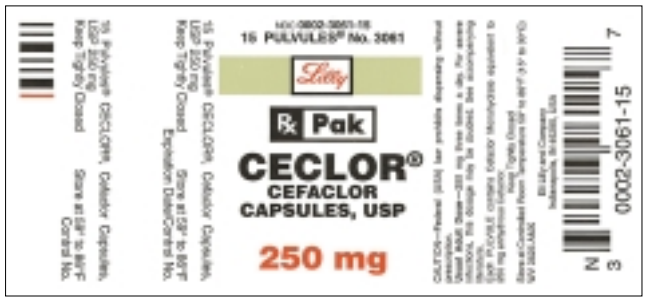
3. *Analyze what assessments you would make if you suspect that a patient receiving a cephalosporin is experiencing Stevens-Johnson syndrome.*

## Review Questions

1. The nurse observes a patient taking a cephalosporin for common adverse reactions, which include_____.
   - **A.** hypotension, dizziness, urticaria
   - **B.** nausea, vomiting, diarrhea
   - **C.** skin rash, constipation, headache
   - **D.** bradycardia, pruritus, insomnia
2. When giving a cephalosporin by the intramuscular route, the nurse tells the patient that _____.
   - **A.** a stinging or burning sensation and soreness at the site may be experienced
   - **B.** the injection site will be red for several days
   - **C.** all injections will be given in the same area
   - **D.** the injection will not cause any discomfort
3. A nurse asks why it is so important to determine if the patient is allergic to penicillin before the first dose of the cephalosporin is given. The most correct answer is that persons allergic to penicillin _____.
   - **A.** are usually allergic to most antibiotics
   - **B.** respond poorly to antibiotic therapy
   - **C.** require higher doses of other antibiotics
   - **D.** have a higher incidence of allergy to the cephalosporins
4. The nurse observes a patient receiving a cephalosporin for the Stevens-Johnson syndrome. The signs and symptoms that might indicate this syndrome include _____.
   - **A.** swelling of the extremities
   - **B.** increased blood pressure and pulse rate
   - **C.** lesions on the skin and/or mucous membranes
   - **D.** pain in the joints

## ● Medication Dosage Problems

**1.** Ceclor 500 mg is prescribed for a patient. Use the drug label below to determine the dosage.




The nurse would administer _____.

**2.** The physician prescribes 1 g of Mefoxin (cefoxitin) for parenteral administration. Mefoxin is available in a solution of 250 mg/1 mL. What amount of Mefoxin would the nurse prepare? _____