

chapter 34

Beta-Lactam Antibacterials: Penicillins, Cephalosporins, and Others

Objectives

AFTER STUDYING THIS CHAPTER, THE STUDENT WILL BE ABLE TO:

1. Describe general characteristics of beta-lactam antibiotics.
2. Discuss penicillins in relation to effectiveness, safety, spectrum of antimicrobial activity, mechanism of action, indications for use, administration, observation of client response, and teaching of clients.
3. Differentiate among extended-spectrum penicillins.
4. Question clients about allergies before the initial dose of a penicillin.
5. Describe characteristics of beta-lactamase inhibitor drugs.
6. State the rationale for combining a penicillin and a beta-lactamase inhibitor drug.
7. Discuss similarities and differences between cephalosporins and penicillins.
8. Differentiate cephalosporins in relation to antimicrobial spectrum, indications for use, and adverse effects.
9. Describe major characteristics of carbapenem and monobactam drugs.
10. Apply principles of using beta-lactam antimicrobials in selected client situations.

Critical Thinking Scenario

Kurt, 5 months of age, is brought to the urgent care center at 4 am. He has had a cold for 3 days and started to run a high temperature (over 39°C) last evening. His parents are visibly upset and worried. He has been crying continuously for the last 8 hours and appears to be in pain. The physician examines him and tells the parents he has a middle ear infection, for which he prescribes amoxicillin 200 mg q8h for 10 days.

Reflect on:

- ▶ Factors contributing to the increased incidence of ear infections in this age group.
- ▶ Why amoxicillin is a good choice for treatment. (Hint: think of the spectrum of coverage.)
- ▶ Important teaching to limit the potential for antimicrobial resistance.
- ▶ Factors in the situation that may make learning difficult for the parents, and how you will individualize teaching.

OVERVIEW

Beta-lactam antibacterials derive their name from the beta-lactam ring that is part of their chemical structure. An intact beta-lactam ring is essential for antibacterial activity. Several gram-positive and gram-negative bacteria produce beta-lactamase enzymes that disrupt the beta-lactam ring and inactivate the drugs. This is a major mechanism by which microorganisms acquire resistance to beta-lactam antibiotics.

Penicillinase and cephalosporinase are beta-lactamase enzymes that act on penicillins and cephalosporins, respectively.

Despite the common element of a beta-lactam ring, characteristics of beta-lactam antibiotics differ widely because of variations in their chemical structures. The drugs may differ in antimicrobial spectrum of activity, routes of administration, susceptibility to beta-lactamase enzymes, and adverse effects. Beta-lactam antibiotics include penicillins, cephalosporins, carbapenems, and monobactams, which are