Chapter 46

Antimicrobial Agents

Learning Objectives

- Explain the major action and effects of drugs used to treat infectious diseases
- Identify criteria used to select an effective antimicrobial agent
- Identify baseline data the nurse should collect on a continual basis for comparison and evaluation of antimicrobial drug effectiveness

Learning Objectives (cont’d)

- Describe the nursing assessments and interventions for the common side effects associated with antimicrobial agents: allergic reaction; direct tissue damage (e.g., nephrotoxicity, ototoxicity, hepatotoxicity); secondary infection; and other considerations such as photosensitivity, peripheral neuropathy, and neuromuscular blockage

Learning Objectives (cont’d)

- Identify significant data in a patient history that could alert the medical team that a patient is more likely to experience an allergic reaction
- Describe basic principles of patient care that can be implemented to enhance an individual’s therapeutic response during an infection

Medical Terminology

- Septic
- Sepsis
- Septicemia
- Sept/o, Septic/o

Medical Terminology

- Any word that ends with “itis” means inflammation or infection of that organ.
- Examples:
  - Meningitis — infection of the sack around the brain
  - Encephalitis — inflammation or infection of the brain
- Rhinitis — inflammation or infection of the nose
- Sinusitis — inflammation or infection of the sinuses
- Pharyngitis — inflammation or infection of the throat
- Bronchitis — inflammation or infection of the upper airways
- Pneumonitis — inflammation or infection of the lung

Medical Terminology
- Pericarditis — inflammation or infection of the sack around the heart
- Myocarditis — inflammation or infection of the muscle of the heart
- Esophagitis — inflammation or infection of the esophagus
- Hepatitis — inflammation or infection. Examples are virus infections and drug reactions.
- Gastritis — inflammation or infection of the stomach
- Gastroenteritis — inflammation or infection of the stomach and bowels
- Dermatitis — inflammation or infection of the skin

Antimicrobial Agents
- Antibiotics: classified according to type of pathogen they are effective against
  - Antibacterial
  - Antifungal
  - Antiviral
- Further classification according to chemical family
- Selection of the Antimicrobial Agent
- Sensitivity of the pathogen
- Toxicity potential to the patient
- Isolate and identify offending organism whenever possible
- Culture and sensitivity testing
- Clinical judgment
- Nursing Process for Antimicrobial Therapy
- History of current infection
- Past history
- Allergies
Nursing Process for Antimicrobial Therapy (cont’d)

Assessments during antimicrobial therapy
- Nausea, vomiting, diarrhea
- Secondary infection
- Allergies and anaphylaxis
- Nephrotoxicity
- Hepatotoxicity
- Ototoxicity
- Blood dyscrasias
- Photosensitivity

Nursing Process for Antimicrobial Therapy (cont’d)

Drug administration
- Timing
- With meals or before or after meals
- Hydration
- Drug-drug or drug-food interactions
- Finish all medication prescribed
- Education

Learning Objectives

Develop a plan for implementing patient education for patients receiving aminoglycosides, carbapenems, cephalosporins, gly cyclines, ketolides, penicillins, quinolones, streptogramins, sulfonamides, tetracyclines, antifungal agents, and antiviral agents

Differentiate between gram-negative and gram-positive microorganisms and between anaerobic and aerobic properties of microorganisms

Cell Structure
Drug Class: Aminoglycosides
Inhibit protein synthesis
Effective against gram-negative organisms that cause urinary infections, meningitis, wound infections, and sepsis
- Kanamycin (Kantrex)
- Neomycin
- Gentamicin
- Amikacin
- Tobramycin

Drug Class: Carbapenems
Inhibit bacterial cell wall synthesis
Potent broad spectrum
Resistant to beta-lactamase enzymes
- Ertapenem (Ivanz)
- Imipenem (Primaxin)
- Meropenem (Merrem IV)

Drug Class: Cephalosporins
Inhibit bacterial cell wall synthesis
Related to penicillins
1st generation effective against gram-positive microorganisms
2nd and 3rd generation have increased activity against gram-negative organisms
4th generation is broad spectrum
- Cefadroxil (1st)(Duricef)
- Cefmetazole (2nd)(Zefazone)
- Cefdinir (3rd)(Omnicef)
- Cefepime (4th)(Maxipime)

Drug Class: Glycyclines
New family of antibiotics
- Tigecycline(Tygaril) first drug
Binds to 30S ribosome, preventing protein synthesis
Bacteriostatic
- Used to treat broad-spectrum gram-positive, gram-negative, and anaerobic infections
- Drug Class: Ketolides
- Bactericidal
- Prevent bacterial ribosomes from translating its mRNA into new protein
- Used to treat acute bacterial sinusitis, bronchitis, and lung infections
- Treats gram-positive infections
- Drug Class: Macrolides
- Inhibit protein synthesis
- Bacteriostatic and bactericidal
- Used for respiratory, gastrointestinal tract, skin, and soft tissue infections
- Used when penicillins, cephalosporins, and tetracyclines are contraindicated
  - Erythromycin
  - Azithromycin (Zithromax)
  - Clarithromycin (Biaxin)
- Drug Class: Penicillins
- Inhibit cell wall synthesis
- Significance of penicillinase-resistant penicillins
- Used for ear infections, pneumonia, meningitis, urinary tract infections, syphilis, gonorrhea
  - Amoxicillin
  - Ampicillin
  - Dicloxacillin
  - Amoxicillin and potassium clavulanate
- Drug Class: Quinolones
- Treats wide range gram + and gram – bacteria
- Inhibit activity of enzyme that makes DNA
- Ciprofloxacin (Cipro)-UTI
- Levofloxacin (Levaquin)-upper resp, pneumonia, UTI
- Drug Class: Streptogramins
- Inhibit protein synthesis
- New class developed from pristamycin
Quinupristin/dalfopristin: can be used to treat vancomycin-resistant Enterococcus faecium

Drug Class: Sulfonamides
- Inhibit bacterial biosynthesis of folic acid resulting in cell death
- Used to treat urinary tract infections and otitis media
- Used prophylactically in patients susceptible to streptococcal infection or rheumatic fever when penicillin is contraindicated
  - Trimethoprim/sulfamethoxazole (co-trimoxazole) (Bactrim, Septra)

Drug Class: Tetracyclines
- Inhibit protein synthesis
- Used to treat venereal diseases, UTIs, URTIs, pneumonia, and meningitis when penicillin is contraindicated
  - Demeclocycline
  - Doxycycline (Vibramycin)
  - Minocycline

Drug Class: Antitubercular Agents
- Ethambutol
- Isoniazid: prevention and treatment, but action unknown
- Rifampin
- Treatment for tuberculosis is multifaceted and protracted

Learning Objectives
- Identify criteria used to select an effective antimicrobial agent
- Review parenteral administration techniques and the procedure for vaginal insertion of drugs

Learning Objectives (cont’d)
- Develop a plan for implementing patient education for patients receiving aminoglycosides, carbapenems, cephalosporins, glycyclines, ketolides, penicillins, quinolones, streptogramins, sulfonamides, tetracyclines, antifungal agents, and antiviral agents
Drug Class: Miscellaneous Antibiotics
- Aztreonam
- Chloramphenicol
- Clindamycin
- Daptomycin
- Metronidazole (Flagyl)
- Spectinomycin—treats gonorrhea
- Tinidazole
- Vancomycin

Drug Class: Topical Antifungal Agents
- Used to treat tinea pedis, tinea cruris, tinea corporis, tinea versicolor, and candida infections
- Clotrimazole (gyne-lotrimin)
- Ketoconazole (Nizoral)
- Ciclopirox
- Nystatin
- Terbinafine (Lamisil)

Drug Class: Systemic Antifungal Agents
- Disrupt cell membrane of fungal cells
  - Amphotericin B: systemic fungal infections and meningitis, topical candidiasis
  - Fluconazole (Diflucan)
  - Flucytosine
  - Griseofulvin—treats ringworm
  - Itraconazole—do not use in heart failure
  - Ketoconazole
  - Terbinafine (Lamisil)—nail fungi

Drug Class: Antiviral Agents
Abacavir: HIV-1
Acyclovir: herpes
Amantadine hydrochloride: influenza A
Amprenavir: HIV-1
Atazanavir: HIV-1
Didanosine: HIV-1
Efavirenz: HIV-1 (but not as sole agent)
Emtricitabine: HIV-1
Enfuvirtide: HIV-1

Drug Class: Antiviral Agents (cont’d)
Famciclovir: genital herpes, herpes zoster
Lamivudine: HIV-1, hepatitis B
Oseltamivir: (Tamiflu)influenza
Ribavirin: RSV and hepatitis C (in combination with interferon alpha-2b)
Stavudine: HIV-1
Valacyclovir: (Valtrex) acute herpes zoster
Zanamivir: influenza
Zidovudine: HIV-1

Review Questions
Name drug classes that can cause ototoxicity
Name drug classes that can cause photosensitivity