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When you have to be right

Introduction to Clinical Pharmacology

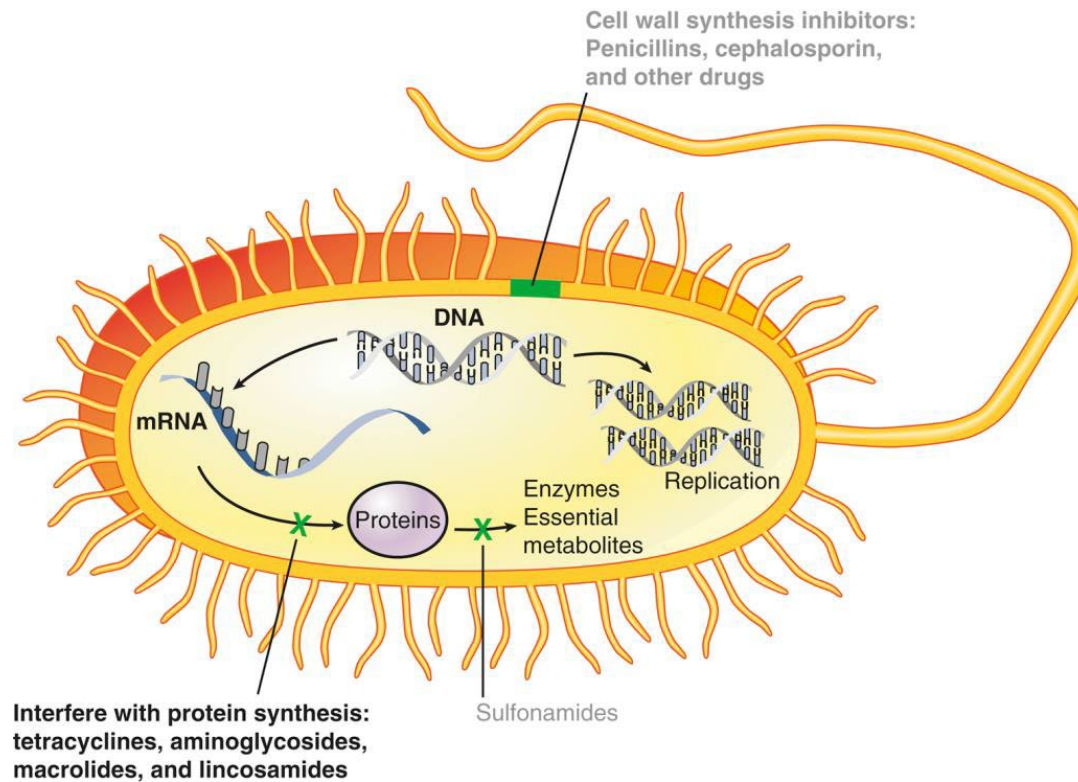
Chapter 8

Antibacterial Drugs That Interfere With Protein Synthesis

Learning Objectives

1. Explain the uses, general drug actions, adverse reactions, contraindications, precautions, and interactions of antibacterial drugs that interfere with protein synthesis.
2. Distinguish important preadministration and ongoing assessment activities the nurse should perform on the client taking an antibacterial drug that interferes with protein synthesis.
3. List nursing diagnoses particular to a client taking an antibacterial drug that interferes with protein synthesis.
4. Examine ways to promote an optimal response to therapy, how to manage adverse reactions, and important points to keep in mind when educating clients about the use of antibacterial drugs that interfere with protein synthesis.

Antibiotics That Interfere With Protein Synthesis



Tetracyclines—Actions

- ❖ Group of antibacterial drugs composed of natural and semisynthetic compounds
- ❖ Action—Inhibit bacterial protein synthesis



Tetracyclines—Uses

- ❖ Used when a client is allergic to penicillins or cephalosporins
- ❖ Used against a wide range of gram-negative and gram-positive microorganisms:
 - *E. coli* infections
 - Respiratory infections
 - Rickettsial diseases
 - Intestinal amebiasis
 - Some skin and soft tissue infections
 - Uncomplicated urethral, endocervical, or rectal infection caused by *Chlamydia trachomatis*
 - Severe acne as an adjunctive treatment
 - Infection with *Helicobacter pylori* in combination with metronidazole and bismuth subsalicylate

Tetracyclines—Adverse Reactions

❖ Common Gastrointestinal System Reactions:

- Nausea, vomiting
- Diarrhea
- Epigastric distress
- Stomatitis (inflammation of the mouth)



❖ Other Common Reactions

- Sore throat
- Skin rashes
- Photosensitivity

Tetracyclines—Contraindications

- ❖ Contraindicated in clients:
 - With hypersensitivity to any tetracyclines; during pregnancy (pregnancy category D), lactation; children younger than 9 years
- ❖ Used cautiously in clients with impaired renal function and liver impairment
- ❖ Prolonged therapy can lead to bacterial/fungal overgrowth of nonsusceptible organisms
- ❖ Nursing alert:
 - Not given to children younger than 9 years due to yellow-gray-brown discoloration of the teeth



Tetracyclines—Interactions

Interacting Drug	Common Use	Effect of Interaction
Antacids containing aluminum, zinc, magnesium, or bismuth salts	Relief of heartburn and GI upset	Decreased effectiveness of tetracyclines
Oral contraceptives	Contraception	Decreased effectiveness of contraceptive agent
Oral anticoagulants	Prevent blood clots	Increased bleeding risks
Digoxin	Management of heart disease	Increased risk for digitalis toxicity

Aminoglycosides—Actions

- ❖ Bactericidal—Block the ribosome from reading the mRNA, one of the steps in protein synthesis necessary for bacterial multiplication
- ❖ Primarily act against gram-negative bacilli
- ❖ Partially act against gram-positive bacilli
- ❖ Can easily produce toxin reactions (neuro-, oto-, and nephrotoxicities)
- ❖ Oral aminoglycosides are poorly absorbed



Aminoglycosides—Uses

- ❖ Used primarily to treat gram-negative infections:
 - Hepatic coma—reduces number of ammonia-forming bacteria in the intestines so blood ammonia levels may be lowered
- ❖ Prophylactically:
 - To reduce bacteria in the bowel prior to abdominal surgery—“bowel preparation”

Aminoglycosides—Adverse Reactions

❖ Common Gastrointestinal System Reactions:

- Nausea
- Vomiting
- Anorexia
- Rash
- Urticaria
- Mild hypersensitivity
- Bacterial or fungal superinfection

❖ Serious Reactions

- Nephrotoxicity
- Ototoxicity
- Neurotoxicity
- Serious reactions are more common in clients with impaired renal function
- Serious hypersensitivity



Aminoglycosides—Contraindications

- ❖ Aminoglycosides should not be administered in clients with:
 - Hypersensitivity to aminoglycosides
 - Preexisting hearing loss
 - Myasthenia gravis
 - Parkinson disease
 - Lactation and pregnancy (pregnancy category D)
 - Who need long term therapy—increased potential for ototoxicity and nephrotoxicity
- ❖ Aminoglycosides should be used cautiously in:
 - Older clients
 - Clients with renal failure
 - Clients with neuromuscular disorder



Aminoglycosides—Interactions

Interacting Drug	Common Use	Effect of Interaction
Cephalosporins	Anti-infective	Increases risk for nephrotoxicity
Loop diuretics	Management of edema and water retention	Increased risk of ototoxicity
Pavulon or Anectine (general anesthetics)	Anesthesia (i.e., for surgery)	Increased risk of neuromuscular blockade

Macrolides—Actions

- ❖ Effective against a wide variety of pathogenic organisms, particularly infections of the respiratory and genitourinary tracts
- ❖ Actions:
 - Can be bacteriostatic or bactericidal
 - Act by causing changes in protein function and synthesis



Macrolides—Uses

❖ Used as prophylaxis before dental or other procedures in clients allergic to penicillin and in the treatment of:

- A wide range of gram-negative and gram-positive infections
- Acne vulgaris and skin infections
- Upper respiratory infections caused by *Haemophilus influenzae*



Macrolides—Adverse Reactions

❖ Common Gastrointestinal System Reactions:

- Nausea
- Vomiting
- Diarrhea
- Abdominal pain or cramping
- Risk of pseudomembranous colitis



Macrolides—Contraindications

❖ Contraindicated in clients:

- With allergies/hypersensitivity to macrolides
- With preexisting liver disease

❖ Macrolides should be used cautiously in clients with:

- Liver dysfunction
- Myasthenia gravis
- Lactation/pregnancy (pregnancy category C)



Macrolides—Interactions

Interacting Drug	Common Use	Effect of Interaction
Antacids (kaolin, aluminum salts, or magaldrate)	Relief of GI upset—diarrhea	Decreased absorption and effectiveness of the macrolides
Digoxin	Management of cardiac disorders	Increased serum levels
Anticoagulants	Prevents blood clots	Increased risk of bleeding
Clindamycin, lincomycin, or chloramphenicol	Anti-infective agent	Decreased therapeutic activity of the macrolides
Theophylline	Management of respiratory problems, such as asthma	Increased serum theophylline level

Lincosamides—Actions and Uses

- ❖ Used for treating serious infections in which penicillin or erythromycin is not effective
- ❖ Used for the more serious infections
- ❖ Used in conjunction with other antibiotics
- ❖ Actions:
 - Inhibits protein synthesis in susceptible bacteria, causing cell death
 - Disrupt the functional ability of ribosomes causing cell death
- ❖ Effective in the treatment of infections caused by a wide range of gram-negative and gram-positive microorganisms



Lincosamides—Adverse Reactions

❖ Common Gastrointestinal System Reactions:

- Nausea
- Vomiting
- Diarrhea
- Abdominal pain
- Esophagitis
- Pseudomembranous colitis

❖ Other Common Reactions

- Skin rashes
- Blood dyscrasias



Lincosamides—Contraindications

❖ Contraindicated in clients:

- With hypersensitivity to the lincosamides
- Having minor bacterial or viral infections

❖ Used cautiously in clients with:

- History of GI disorders
- Renal disease
- Liver impairment
- Myasthenia gravis



Lincosamides—Interactions

Interacting Drug	Common Use	Effect of Interaction
Kaolin- or aluminum-based antacids	Relief of stomach upset	Decreased absorption of the lincosamides
Neuromuscular blocking drugs	Anesthesia	Increased action of neuromuscular blocking drug, possible leading to severe and profound respiratory depression

Miscellaneous Drugs Inhibiting Protein Synthesis—Actions

- ❖ Daptomycin—cyclic lipopeptides
- ❖ Linezolid—first drug in a new drug class (oxazolidinones)
- ❖ Quinupristin/dalfopristin—bacterial action against both methicillin-susceptible and methicillin-resistant staphylococci

Miscellaneous Drugs Inhibiting Protein Synthesis—Uses

- ❖ Daptomycin used to treat complicated skin structure bacterial infections and *Staphylococcus aureus* infections in the blood
- ❖ Linezolid is used for
 - skin and skin structure infections caused by methicillin-resistant *S. aureus* (MRSA) infections
 - vancomycin-resistant *Enterococcus faecium* (VREF) health care-acquired and community-acquired pneumonias
- ❖ Quinupristin/dalfopristin used in the treatment of VREF

Miscellaneous Drugs Inhibiting Protein Synthesis—Adverse Reactions

❖ Most Common Reactions:

- Nausea
- Vomiting
- Diarrhea or constipation
- Headache and dizziness
- Insomnia
- Rash
- Chills

❖ Less Common Reactions:

- Fatigue
- Depression
- Nervousness
- Photosensitivity

❖ Most Serious Reactions

- Pseudomembranous colitis
- Thrombocytopenia



Nursing Alert—Miscellaneous Drugs Inhibiting Protein Synthesis

- ❖ Quinupristin/dalfopristin is irritating to the vein
- ❖ After IV infusion the vein should be flushed with 5% dextrose in water (D₅W) because this drug is incompatible with saline or heparin flush solutions



Miscellaneous Drugs Inhibiting Protein Synthesis— Contraindications

❖ Contraindications

- Linezolid is contraindicated in clients who are pregnant (pregnancy category C), lactating, clients with phenylketonuria (PKU)
- Daptomycin and quinupristin/dalfopristin is contraindicated in clients with know hypersensitivity, who are pregnant (pregnancy category B), or lactating

❖ Precautions

- Linezolid is used cautiously in clients with bone marrow depression, hepatic dysfunction, renal impairment, hypertension, and hyperthyroidism
- If needed for prolonged use monitor for secondary bacteria lor infections



Linezolid–Interactions

Interacting Drug/Food	Common Use	Effect of Interaction
Antiplatelet	Prevent blood clots	Increased risk of bleeding and thrombocytopenia
Monoamine oxidase inhibitors (MAOI)	Management of depression	Decreased effectiveness
Food containing large amounts tyramine (e.g., aged cheese, caffeinated beverages, yogurt, chocolate, red wine, beer, and pepperoni)	Nutrition/Dietary preference	Risk of severe hypertension

Daptomycin—Interactions

Interacting Drug	Common Use	Effect of Interaction
Statin drugs	Cholesterol reduction	Myopathy with elevated creatinine phosphokinase (CPK)
Warfarin	Blood thinner	Increased bleeding time (prolonged PT-INR)

Quinupristin/dalfopristin—Interactions

Interacting Drug	Common Use	Effect of Interaction
Antiretrovirals	HIV/AIDS	Serum level of antiretroviral drug will increase
Antineoplastics	Prevent, inhibit, or treat tumors and cancers	Serum level of antineoplastic drug will increase
Immunosuppressant agents	Prevents rejection of organ transplant or treat autoimmune diseases	Serum level of immunosuppressant drug will increase
Calcium-channel blockers	Treats high blood pressure	Serum level of calcium-channel blocking drug will increase
Benzodiazepines	Anti-anxiety, seizures, insomnia	Serum level of benzodiazepine drug will increase
Cisapride	Treats nighttime heartburn	Serum levels of cisapride will increase

Pharmacology in Practice Exercise #1

- ❖ The client has been prescribed a drug from the class of tetracyclines. Infections are treated by inhibiting which of the following cellular actions?
- a) Protein synthesis
 - b) Bacterial cell wall synthesis
 - c) Inhibiting bacterial DNA gyrase
 - d) Depolarizing the bacterial cell wall



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #1

❖ Preadministration Assessment

❖ Objective Data

- Description of the external signs of infection (drainage, redness, changes in appearance of sputum, cough, and swelling)
- Vital signs
- Infection culture results
- Renal and hepatic function tests, complete blood count, and urinalysis (if client has history of impaired function)
- Hearing test results (in client with history of impaired hearing)
- When used for hepatic coma, level of consciousness and ability to swallow

Nursing Process—Client Receiving Antibacterial Interfering with Protein Synthesis #2

❖ Preadministration Assessment (continued)

❖ Subjective Data

- Client description of infection including pain, malaise, chills, and fever
- Type and duration of symptoms
- Allergy history
- Remedies attempted before seeking care

Nursing Process—Client Receiving Antibacterial Interfering with Protein Synthesis #3

❖ Ongoing Assessment

- Take vital signs every 4 hours or as ordered
- Notify the primary health care provider if there are changes in the vital signs or if signs and symptoms worsen
- Compare current signs and symptoms of infection with baseline and/or previous assessments and record any specific findings



Pharmacology in Practice Exercise #2

- ❖ The client has been administered a tetracycline drug. Which of the following should the nurse immediately report to the primary health care provider during the ongoing assessment of the client? Select all that apply.
- a) Drop in blood pressure
 - b) Regular urine output
 - c) Increase in pulse rate
 - d) Normal blood sugar level
 - e) Increase in temperature



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #4

❖ Nursing Diagnoses

- Impaired Comfort: Increased Fever related to ineffectiveness of anti-infective therapy
- Acute Confusion related to increased ammonia blood levels
- Ineffective Tissue Perfusion: Renal related to adverse drug reactions to aminoglycosides
- Risk for Injury related to paresthesia secondary to neurotoxicity or auditory damage from aminoglycosides
- Diarrhea related to superinfection secondary to anti-infective therapy or adverse drug reaction

Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #5

❖ Planning

- Expected client outcomes depend on the reason for administration of the antibiotic but may include:
 - Controlling the infectious process or prophylaxis of bacterial infection
 - Management of adverse drug effects
 - Confidence and understanding of the prescribed treatment regimen

Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #6

❖ Implementation—Oral administration: tetracyclines

○ Promoting an optimal response to therapy

- Have the client take the drug on an empty stomach and with a full glass of water (exceptions: minocycline and tigecycline can be taken with food)
- Nursing alert: do not give with dairy products, antacids, laxatives, or products containing iron; if prescribed, give 2 hours before/after administration of tetracycline
- Food or drugs containing calcium, magnesium, aluminum, or iron prevent the absorption of tetracyclines if ingested concurrently



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #7

❖ Implementation—Oral administration: aminoglycosides

- Promoting an optimal response to therapy
 - Enteric-coated erythromycin may be given with neomycin due to the coating preventing the drug being absorbed in the stomach
 - Drug delivery timing is critical for optimal response of suppression of intestinal bacteria when preparing a client for surgery



Nursing Process—Client Receiving Antibacterial Interfering with Protein Synthesis #8

❖ Implementation—Oral administration: macrolides

- Promoting an optimal response to therapy
 - Administered without regard to meals and with milk
 - Exceptions:
 - Azithromycin—given 1 hour or more before a meal or 2 hours or more after a meal
 - Erythromycin—given on an empty stomach (1 hour or more before a meal or 2 hours or more after a meal) and with 180 to 280 mL of water



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #9

❖ Implementation—Oral administration: lincosamides

- Promoting an optimal response to therapy
 - Food impairs absorption
 - Client should not take anything by mouth (except water) for 1 to 2 hours before and after
 - Clindamycin can be taken with food or a full glass of water



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #10

❖ Implementation—Parenteral Administration

- Promoting an optimal response to therapy
 - Intramuscularly:
 - Inspect previous injection sites for signs of pain, tenderness, redness, or swelling
 - Assess for temporary local reactions and report to primary health care provider if the localized reaction is persistent
 - Rotate injection sites; record site
 - Intravenously:
 - Inspect needle site and area around needle for signs of extravasation of the IV fluid or tenderness, pain, and redness (signs of phlebitis or thrombophlebitis)
 - In case of symptoms: restart the IV in another vein; report to primary health care provider

Pharmacology in Practice Exercise #3

- ❖ The client appears confused as the nurse is discussing tetracycline administration with them. Which of the following is a priority concept for the nurse to include in the client teaching plan?
- a) Take the drug on an empty stomach
 - b) Take the drug just before a meal
 - c) Take the drug with milk
 - d) Take the drug only at bedtime



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #11

❖ Implementation—Monitoring and Managing Client Needs

- Observe client: frequent intervals, especially first 48 hours of therapy
- Report: any adverse reaction before next dose
- Report serious adverse reactions: severe hypersensitivity reaction, respiratory difficulty, severe diarrhea, severe drop in blood pressure

Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #12

❖ Implementation—Monitoring and Managing Client Needs

- Impaired Comfort: Increased Fever
 - Monitor: temperature at frequent intervals
 - Elevated temperature: check temperature, pulse, and respirations every hour until temperature returns to normal; administer antipyretic medication if prescribed



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #13

- ❖ Implementation—Monitoring and Managing Client Needs
 - Acute Confusion: Hepatic Coma
 - Monitor level of consciousness—in early stages of treatment of hepatic coma with aminoglycosides, various changes in levels of consciousness can occur
 - Monitor for difficulty swallowing—danger of aspiration
 - If client appears to have difficulty taking an oral drug, withhold the drug and notify the provider

Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #14

❖ Implementation—Monitoring and Managing Client Needs

- Ineffective Tissue Perfusion: Renal
 - A client taking aminoglycosides is at risk for nephrotoxicity—monitor for signs and symptoms
 - Assess appearance of urine and measure and record intake and output—notify primary health care provider if there are changes in the appearance of urine or if output is less than 750 mL/day
 - Take a daily weight
 - Encourage fluid intake of 2,000 mL/day
 - Monitor labs (serum creatinine and BUN)—report elevated levels to primary health care provider

Nursing Process—Client Receiving Antibacterial Interfering with Protein Synthesis #15

❖ Implementation—Monitoring and Managing Client Needs

○ Risk for Injury

- Aminoglycosides—report symptoms of neuromuscular blockade or respiratory paralysis (i.e., any difficulty breathing) immediately to the primary health care provider
- Monitor for symptoms of neurotoxicity (i.e., numbness or tingling, circumoral paresthesia, peripheral paresthesia, tremors, muscle twitching, or weakness) and report any symptoms immediately to the primary health care provider
- Monitor for signs and symptoms of ototoxicity (i.e., ringing in ears, difficulty hearing, or dizziness) and report and symptoms immediately to the primary health care provider

Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #16

❖ Implementation—Monitoring and Managing Client Needs

○ Diarrhea

- Observe for and report symptoms of bacterial or fungal superinfection
- Inspect stools for blood and mucus and report abnormalities to provider
- Save sample of stool and test for occult blood and/or sent to lab to rule out C. diff.
- Prevent the spread of infection to other clients with good handwashing/appropriate precautions
- Encourage fluids and maintain an accurate intake and output record

fecal occult blood testing



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #17

❖ Implementation—Educating the Client and Family

- Develop a teaching plan for the client and family to include:
 - Advise to take drug at prescribed time intervals and to not increase or omit dosage unless advised
 - Explain the importance of completing the entire course of treatment
 - Advise taking dose with a full glass of water
 - Explain necessity of notifying primary health care provider if symptoms worsen

Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #18

❖ Implementation—Educating the Client and Family (continued)

- Develop a teaching plan for the client and family to include:
 - Advise to avoid alcoholic beverages during therapy
 - If tetracycline is prescribed: advise to avoid exposure to the sun or tanning lamps or beds; completely cover arms and legs and wear wide-brimmed hat to protect face and neck; sunscreen: may or may not be effective; consult primary health care provider
 - Educate client about foods or beverages that may inhibit the effectiveness of their medication



Nursing Process—Client Receiving Antibacterial Interfering With Protein Synthesis #19

❖ Evaluation

- Was the therapeutic effect achieved? Infection is controlled?
- Were adverse reactions: identified, reported, and managed?
 - Client is afebrile
 - Orientation and mentation remain intact
 - Adequate renal tissue perfusion
 - No evidence of injury due to visual or auditory disturbances
 - Client does not experience or is able to manage diarrhea
- Did client and family express confidence and demonstrate understanding of drug regimen?

Turn and Talk—Case Study

- ❖ A 24-year-old woman presents to the physician's office today seeking treatment for acne. Her only medication is Ortho Tri-Cyclen Lo, an oral contraceptive. The physician writes a prescription for doxycycline 150 mg once daily.
- 1. What should the nurse tell the client about taking oral contraception with doxycycline?
- 2. What adverse reactions should the nurse discuss with the client?
- 3. How should the nurse tell the client to take the doxycycline?

