جامعة الانبار قسم التقنيات الاحيائية

كلية العلوم المادة: الاحياء المجهرية

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Antimicrobial Drugs

Introduction

I. An antimicrobial drug is a chemical substance that destroys pathogenic microorganisms with minimal damage to host tissues.
2. Chemotherapeutic agents include chemicals that combat disease in the body.

The History of Chemotherapy

I. Paul Ehrlich developed the concept of chemotherapy to treat microbial diseases; he predicted the development of chemotherapeutic agents, which would kill pathogens without harming the host.
2. Sulfa d rugs came into prominence in the late 1930s.
3. Alexander Fleming discovered the first antibiotic, penicillin, in 1929; its first clinical trials were done in 1940.

The Spectrum of Antimicrobial Activity

1. Antibacterial drugs affect many targets in a prokaryotic cell.
2. Fungal, protozoan, and helminthic infections arc more difficult to treat because these organisms have eukaryotic cells.
3. Narrow-spectrum drugs affect only a select group of microbes gram-positive cells, for example; broad-spectrum drugs affect a more diverse range of microbes.
4. Small, hydrophilic drugs can affect gram-negative cells.
5. Antimicrobial agents should not cause excessive harm to normal microbiota.
6. Super infections o(Cur when a pathogen develops resistance to the drug being used or when normally res istant microbiota multiply

excessively.

The Action of Antimicrobial Drugs

I. General action is either by directly killing microorganisms (bactericidal) or *by* inhibiting their growth (bacteriostatic).
2. Some agents, such as penicillin, inhibit cell wall synthesis in bacteria.

3. Other agents, such as chloramphenicol, tetracyclines, and streptomycin, inhibit protein synthesis by ac ting on 70S ribosomes.
4. Antifungal agents target plasma membranes.
5. Some agents inhibit nucleic acid synthesis.
6. Agents such as sulfanilamide act as antimetabolites by competitively inhibiting enzyme activity.

A Survey of Commonly Used Antimicrobial Drugs

Antibacterial Antibiotics: Inhibitors of Cell Wall Synthesis

I. All penicillins contain a IB-lactam ring.
2. Natural penicillins produced by *Penicillium* are effective against gram-positive cocci and spirochetes.
3. Penicillinases (B-Lactamases) are bacterial enzymes that destroy natural penicillins.
4. Semisynthetic penicillins are made in the laboratory by adding different side chains onto the IB-lactam ring made by the fungus .
5. Semisynthetic penicillins are resistant to penicillinases and have a broader spectrum of activity than natural penicillins.
6. Carbapcnems are broad-spectrum antibiotics that inhibit cell wall synthesis.
7. The monobactam aztreonam affects only gram-negative bacteria.
8. Cephalosporins inhibit cell wall synthesis and arc used against penicillin-resistant strains.
9. Polypeptides such as bacitracin inhibit cell wall synthesis primarily in gram-positive bacteria.
10. Vancomycin inhibits cell wall synthesis and may be used to kill penicillinase-producing staphylococci.

Antimycobacterial Antibiotics

11. Isoniazid (IN H) and ethambutol inhibit cell wall synthesis in Mycobacteria.

Inhibitors of Protein Synthesis

12. Chloramphenicol, aminoglycosides, tetracyclines, macrolides, and streptogramins inhibit protein synthesis at 70S ribosomes.
13. Oxazolidinones prevent formation of 70S ribosomes.

Injury to the Plasma Membrane

14. A new class of antibiotics inhibits fatty-acid synthesis, essential for plasma membranes.
15. Polymyxin B and bacitracin Cause damage to plasma membranes.

Inhibitors of Nucleic Acid (DNA/RNA) Synthesis

16. Rifamycin inhibits mRNA synthesis; it is used to treat tuberculosis.
17. Quinolones and fluoroquinolones inhibit DNA gyrase for treating urinary tract infections.

Competitive Inhibitors of the Synthesis of Essential Metabolites

18. Sulfonamides competitively inhibit folic acid synthesis.
19. TMP-SMZ competitively inhibits dihydrofolic acid synthesis.

Antifungal Drugs

20. Polyenes, such as nystatin and amphotericin B, combine with plasma membrane sterols and are fungicidal.
21. Azoles and aLLylamines interfere with sterol synthesis and are used to treat cutaneous and systemic mycoses.
22. Echinocandins interfere with fungal cell wall synthesis.
23. The antifungal agent flucytosine is an antimetabolite of cytosine.
24. Griseofulvin in terferes with eukaryotic cell division and is used primarily to treat skin infections caused by fungi.

Antiviral Drugs

25. Nucleoside and nucleotide analogs, such as acyclovir and zidovudine, inhibit DNA or RNA synthesis.
26. Inhibitors of viral enzymes are used to treat influenza and H[V infection.
27. Alpha interferons inhibit the spread of viruses to new cdls.

Antiprotozoan and Antihelminthic Drugs

28. Chloroquine, quinacrine, diiodohydroxyquin, pentamidine, and metronidazole are used to treat protozoan infections.
29. Antihelminthic drugs include mebendazole, praziquantel, and ivermectin.

Tests to Guide Chemotherapy

I. Tests are used to determine which chemotherapeutic agent is most likely to combat a specific pathogen.
2. These tests are used when susceptibility cannot be predicted or when drug resistance arises.

The Diffusion Methods

3. In the disk-diffusion test, also known as the Kirby-Bauer test, a bacterial culture is inoculated on an agar medium, and filter paper disks impregnated with chemotherapeutic agents are overlaid on the culture.

4. After incubation, the diameter of the Zone of inhibition is used 10 determine whether the organism is sensitive, intermediate, or resistant to the drug.
5. MIC is the lowest concentration of drug capable of preventing microbial growth; MIC can be estimated using the E test.

Broth Dilution Tests

6. In a broth dilution test, the microorganism is grown in liquid media containing different concentrations of a chemotherapeutic agent.
7. The lowest concentration of a chemotherapeutic agent that kills bacteria is called the minimum bactericidal concentration (MBC).

Resistance to Antimicrobial Drugs

1. Hereditary drug resistance (R) factors are carried by plasmids and transposons.
2. Resistance may be due to enzymatic destruction of a drug, prevention of penetration of the drug to its target site, cellular or metabolic changes at target sites, or rapid efflux of the antibiotic.
3. Resistance can be minimized by the discriminating use of drugs in appropriate concentrations and dosages.

Antibiotic Safety

1. The risk (e,g., side effects) versus the benefit (e.g., curing an infection) must be evaluated prior to using antibiotics.

Effects of Combinations of Drugs

1. Some combinations of drugs are synergistic; they are more effective when taken together.
2. Some combinations of drugs are antagonistic; when taken together, both drugs become less effective than when taken alone.

The Future of Chemotherapeutic Agents

1. Many bacterial diseases, previously treatable with antibiotics, have become resistant to antibiotics,
2. Chemicals produced by plants and animals are providing new antimicrobial agents called antimicrobial peptides.
3. Protein synthesis in pathogens can be blocked by siRNAs.
4. New agents may inhibit bacterial virulence factors.

References': 1- Microbiology an introduction TWELFTH EDITION. Gerard. Tortora.2016.

2- Microbiology an introduction TENTH EDITION. Gerard. Tortora.2010.