BIOP211 – Pharmacology

Tutorial Session 05: Drugs affecting Micro-organisms

5.1 Discuss these pharmaceutical medications

- Penicillins and cephalosporins
- Metronidazole
- Anti-fungals used systemically
- Anti-retrovirals

And your answer should cover the following

(i) Examples and Indications
(ii) Mechanism of action (must state if microbiostatic or microbicidal for bacterial and fungal infections)
(iii) Efficacy and limitations or cautions / contra-indications
(iv) Adverse effects and drug interactions

Mark your own answer using the Pharmacology text or online resources. Alternatively, peer review each other’s answers, allocating 10 marks per drug class or sub-class or drug or drug statement

5.2 Answer True or False, explaining your answer. Feedback is available on the Subject Website, Review Quiz 5

1. The antifungal agent, amphotericin B is nephrotoxic and affects potassium levels in the blood.

2. The toxicity of a number of antiviral agents prohibits their prophylactic use.

3. Some fungi are part of the normal human body flora.

4. Combination antiviral therapy for HIV infection is seldom used because of life-threatening drug interactions.

5. Flucytosine is an antifungal agent that interferes with fungal nucleic acid synthesis.

6. Aciclovir, valaciclovir and famciclovir are all antiherpes virus agents.

7. Macrolides e.g. erythromycin, inhibit bacterial RNA-dependent protein synthesis by binding to the 50S ribosomal subunit.

8. Beta-lactamase inhibitors reduce the effectiveness of ampicillin and amoxycillin.
9. Most penicillins are much more effective against gram-negative than gram-positive bacteria.

10. The second-generation cephalosporins (e.g. cefoxitin and cefaclor) are much more effective against gram-negative bacteria than first-generation cephalosporins (e.g. cephalazin and cephalaxin).

11. Carbapenems, penicillins and cephalosporins have one common mechanism of inhibiting bacterial cell wall synthesis.

12. Cephalosporins are sometime prescribed for patients allergic to penicillins.

13. A tetracycline antibiotic is contraindicated in pregnant women after week 18 and children under 8 years of age, as it causes discolouration of teeth and enamel dysplasia.

14. The antimicrobial agent metronidazole interacts with bacterial or protozoal DNA causing cell death.

15. In the combination amoxycillin plus clavulanic acid, the combination is synergistic at killing bacteria.

16. In patients taking cephalosporins, *Pseudomonas* is a frequent superinfection.

17. Antimicrobial agents that inhibit bacterial cell wall synthesis are also bactericidal agents.

18. The practice of rotating the use of antibiotics in the clinical setting could facilitate the development of antimicrobial drug resistance.

19. Beta-lactamase alters the drug target so that the drug cannot bind to it.

20. Combination antimicrobial drug therapy prevents the emergence of drug resistance.

22. Non-nucleoside reverse transcriptase inhibitors Delavirdine, efavirenz and nevirapine are used in treating HIV infection

23. Vaginal candidiasis often occurs in pregnant women, women on oral contraception and women with diabetes mellitus
5.3 Discuss these antimicrobial drugs and terms. Use your textbook to check answers:

1. A drug used in the treatment of genital herpes, varicella, HSV encephalitis is the drug amantadine (which blocks the uncoating and release of viral nucleic acid).
   **False DNA inhibitor acyclovir has all the above indications.**

2. Anazole is a chemical with an imidazole or triazole with 2 or 3 nitrogens in a ring structure. Drugs ending in –azole, such as ketoconazole, will cause stomach distress, hypersensitivity, fever, chills and a rash
   **True**

3. Amphotericin B is indicated in the treatment of systemic diseases such as cryptococcal meningitis.
   **True**

4. Amphotericin acts on the fungal cell membrane while caspofungin acts as an antifungal agent by inhibiting a cell wall component.
   **True**

5. The antiviral agents that inhibit viral DNA synthesis end in –ciclovir e.g. acyclovir, famciclovir, ganciclovir
   **True**

6. Penicillins, cephalosporins, monobactams and carbapenems all have an essential beta-lactam ring, broken down by beta-lactamase bacterial enzymes.
   **True**

7. Concurrent use of oral contraceptives and ampicillin will decrease the effectiveness of oral contraception
   **True**

8. A bacteriostatic agent is one that inhibits bacterial growth.
   **True**

9. Liberal use of antibiotics in the clinical setting will foster the emergence of drug resistant strains of microorganisms
   **True**

10. Liberal antibiotic therapy has contributed to the emergence of drug resistant strains of bacteria in hospital and community settings.
    **True**

**Textbook Readings**

  Research Overview of Antimicrobial Chemotherapy and Antibiotic Resistance, Antibacterial Drugs, Antifungal and Antiviral Drugs

- Fink, 2012, Pharmacology; Antibiotics, Principles & the Penicillins by Professor Fink, accessed at [https://www.youtube.com/watch?v=EDYfZ-DcNrW&list=PLekhl8ZQS2PahYNzzQow72dLyLAXJ2dDJ&index=24](https://www.youtube.com/watch?v=EDYfZ-DcNrW&list=PLekhl8ZQS2PahYNzzQow72dLyLAXJ2dDJ&index=24)

- Eric's medical lectures, 2013, Mechanisms and classification of antibiotics (antibiotics lecture 3), accessed at [https://www.youtube.com/watch?v=NGwP471sehl](https://www.youtube.com/watch?v=NGwP471sehl)
Handout Session 5 Drugs Affecting Micro-organisms

Important aspects for your Summaries:

- Principles of antibiotic therapy: 4 main mechanisms of action; resistance, superinfection, guidelines for use of antibiotics, role of host defence mechanisms, dosage & duration of therapy.
- Penicillin, cephalosporins, quinolones, macrolide antibiotics; mechanisms of action, main features. Beta-lactamase inhibitors (clavulanate) to overcome resistance in use of penicillins, cephalosporins and Carbapenems. Other aspects of resistance specific to these agents.
- Sulphonamide-trimethoprim combination: aspects of resistance specific to these agents; main features including mechanism of action (synergism)
- Antifungals e.g. Caspofungin, griseofulvin, Amphotericin B, flucytosine, azole antifungals: types of mycoses treated; mechanisms of action, adverse reactions & other main features. Emerging antifungal resistance. Metronidazole used for anaerobic bacterial, protozoal and fungal infections: mechanism of action, indications, main features.
- Antivirals: DNA Polymerase Inhibitors (e.g. acyclovir) mechanism of action, indications and other main features. Antivirals used against Influenza A & B (amantadine and oseltamivir neuraminidase inhibitor): mechanisms of action, main features.
- Anti-retrovirals in the treatment of HIV: nucleoside reverse transcriptase inhibitors (NRTI) e.g. zidovudine; non-nucleoside reverse transcriptase inhibitors (NNRTIs) e.g. efavirenz; Protease Inhibitors (PI) e.g. saquinavir. Enfuvirtide, tenofovir, mechanism of action irreversible blocking of receptor glycoprotein 41, gp41. The need for HAART and other combination therapies to avoid antiretroviral drug resistance.

Revision Questions / Activities from the Reading Guide

1. Discuss the mechanisms of antimicrobials and state if the effect is microbicidal or microbiostatic
   - β-lactams e.g. penicillins, cephalosporins
   - Sulphamethoxazole-trimethoprim
   - Quinolones
   - Macrolides
   - Tetracyclines
   - Metronidazole
   - Flucytosine
   - Amphotericin B
   - Caspofungin.

2. Discuss one major ADR, other than hypersensitivity (type B) or gastrointestinal symptoms for:
   - tetracycline;
   - sulphamethoxazole-trimethoprim
   - erythromycin
   - macrolide
   - penicillins
   - cephalosporins;
   - ciprofloxacin (quinolone)