Introduction to Antibiotics

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Objectives of the Lecture

At the end of lecture, the students should be able to understand the following:

- Classification of antibiotics.

- Misuses of antibiotics.

- Choice of antibiotics.

- Bacterial resistance and ways to prevent it.

- General principles of chemotherapy.

- Indications for antibiotics prophylaxis

Definition of Antibiotics

Chemical substances produced by various microorganisms (bacteria, fungi, actinomycetes) that have the capacity to inhibit or destroy other microorganisms.

Now a day they are chemically synthesized.

They either kill bacteria(bactericidal) or keep more bacteria from growing(bacteriostatic).

Antibiotics will not cure infections caused by viruses.

CLASSIFICATION OF ANTIBIOTICS ACCORDING TO MECHANISM OF ACTION

- **INHIBITION OF CELL WALL SYNTHESIS e.g. Penicillins, Cephalosporin**

- **INHIBITION OF PROTEIN SYNTHESIS e.g. Macrolides, Tetracyclines**

- **INHIBITION OF DNA SYNTHESIS e.g. Quinolones.**

- **INHIBITION OF FOLATE METABOLISM e.g. Sulphonamides, Trimethoprim**

- **INHIBITION OF RNA synthesis by binding to RNA polymerase e.g. Rifampicin.**

According to spectrum

- **Narrow spectrum , e.g.:**

    penicillin G , aminoglycosides

- **Broad spectrum , e.g.:**

    ampicillin , amoxicillin

Choice of Antibiotic

A) Clinical diagnosis
(e.g.,syphylis)

B) Microbiological
information

C) Pharmacological
consideration

B) Bacteriological informations

Advantages

❖   The exact antibiotic to be used

❖   The most effective and reject the one
          with little or no activity

❖   The least toxic

❖   The cheapest

Disadvantages

- The bacteria isolated may not be the prime cause of the disease.

- do not take in consideration site of infection

- some bacteria cannot be cultivated or take time to grow

  (e.g. M. Leprae, M. Tuberculosis)

- Bacteriological services are not available at all hospitals

Choice of Antibiotics(cont.)

C) **Pharmacological consideration**

1. Site of infection

2. Host factors

   a) Immune system e.g. Alcoholism, diabetes, HIV, malnutrition, advanced age- (higher than usual doses or longer courses are required).

   b) Genetic factors

   e.g. Patients with G-6-PD deficiency treated with sulfonamides (Hemolysis)

c) Pregnancy and Lactation

    Aminoglycosides (hearing loss)

     Tetracyclines   (bone deformity)

d) Extreme Age

      Neonates and elderly

e) Renal function

        e.g. Aminoglycosides (renal failure)

f)Liver function

     e.g. Erythromycin(hepatic failure)

3. Drug Allergy

MISUSES OF ANTIBIOTICS

❖ **Treatment of diseases caused by viruses.**

❖ **Improper dosage.**

❖ **Therapy of fever of unknown origin.**

❖ **Presence of pus or necrotic tissues , or blood at the surgical site**

❖ **Excessive use of prophylactic antibiotics in travelers.**

❖ **Lack of adequate bacteriological information.**

❖ **Over use as growth promoters in animals and agriculture.**

❖ **Pts do not take them according to their doctor's instructions.**

❖ **Some pts save unused antibiotics for another illness, or pass to others.**

Reasons for MISUSES of ANTIBIOTICS

A consequence of many factors:
1- Availability of a very wide selection
2- Limitation of physician's time
3- Physician shortage and expenses
4- Availability without Rx in pharmacies
3- Public demand (pressure to prescribe)

Bacterial Resistance

➢ One result of the widespread use of antibiotics has been the emergence of resistant pathogens that have been sensitive in the past.

Definition

Conc of antibiotic required to inhibit or kill the bacteria is greater than the conc that can safely be achieved in the plasma.

Mechanisms of Acquired Antibiotic Resistance

1. Inactivation by enzyme produced by bacteria

Bacterial β-lactamase inactivates penicillins & cephalosporins by cleaving the β-lactam ring of the drug.

2. Bacteria develops an altered receptor for the drug

3. Bacteria develops an altered metabolic pathway

4. Reduced bacterial permeability to antibiotic

5. Actively transporting the drug out of the cell

Prevention of Resistance

*Use antibiotics only when absolutely required

*Use antibiotics in adequate dosage for sufficient period of time

   Not too brief therapy

   Not too prolonged therapy

   (exceptions, e.g. TB)

*Combination of antibiotics may be required to delay resistance (e.g. TB)

General Principles of Chemotherapy

❖ Administer drug in *full dose*, at *proper interval* and by the b*est route*

❖ When apparent cure achieved , continue antibiotic for about 3 days further to avoid relapse

❖ Skipping doses may decrease effectiveness of antibiotic & increase the incidence of bacterial resistance.

❖ In some infections bacteriological proof of cure is
   desirable (e.g. TB, UTI)

❖ Measurement of plasma conc. of antibiotics is seldom needed, except for systemic aminoglycosides(e.g., streptomycin, gentamicin, etc.).

General Principles of Chemotherapy(cont)

❖ **Two or more antimicrobials should not be used without good reason, e.g.:**

    Mixed bacterial (polymicrobial) infections

    Desperately ill patient of unknown etiology

    To prevent emergence of resistance (e.g. TB)

    To achieve synergism

    eg.piperacillin+gentamicin(p. aeruginosae)

Disadvantages of multiple antibiotics

    Increased risk of sensitivity or toxicity

    Increased risk of colonization with a resistant bacteria

    Possibility of antagonism

    Higher cost

Indications for antibiotics prophylaxis

Surgical prophylaxis, e.g.:
bowel surgery, joint replacement,etc. to prevent postoperative infections.

Immunosuppressed Patients, e.g.:
Very old, Very young , Diabetics, Anaemics, AIDS ,Cancer pts.

Dental extractions, e.g.:
Pts with total joint replacements
Pts with cardiac abnormalities