Introduction to phamacodynamics

Pharmacodynamics is the study of drug effects. In other words, what the drug does to the body.

Principles of drug action

Drugs do not impart new functions to any system, organ, or cell; they only alter the pace of ongoing activity.

The basic types of drug action can be broadly classed as:

1. Stimulation – selective enhancement of the level of activity of specialized cells, e.g. adrenaline stimulates the heart.
2. Depression – Selective diminution of activity of specialized cells, e.g. barbiturates depress CNS.
3. Irritation – Mild irritation may stimulate associated function, e.g. bitters increase salivary and gastric secretion.
4. Replacement – Use of natural metabolites, hormones, or their congeners in deficiency states e.g. insulin in diabetes mellitus.
5. Cytotoxic action – kills cancer cells or parasites, bacterial infections; e.g. penicillin, zidovudine

Mechanisms of drug action

1. Physical or chemical property
a. Activated charcoal – adsorptive property
b. Antacids – the neutralization of gastric acid
c. Potassium permanganate – Oxidizing d. Mannitol, magnesium sulfate – osmotic activity
The majority of drugs produce their effects by interacting with a discrete target biomolecule, which usually is a protein.

2. Enzyme

Almost all biological reactions are carried out under the catalytic influence of enzymes; hence, enzymes are a very important target of drug action.

Drugs can either increase or decrease the rate of enzymatic mediated reactions.

Several enzymes are stimulated through receptors and second messengers.

Inhibition of enzymes is a common mode of drug action.

a. Nonspecific inhibition – Many chemicals and drugs are capable of denaturing proteins. They alter the structure of an enzyme that they come into contact with e.g. heavy metal salts, alcohol, phenol, strong acids, and alkalis.

b. Specific inhibition – Many drugs inhibit a particular enzyme without affecting others. Such inhibition can either be :

i. Competitive - the drug is structurally similar competes with the normal substrate for the catalytic binding site of the enzyme so that the product formed is not functional; e.g. sulfonamides compete with PABA for bacterial folate synthetase.
ii. Noncompetitive – the inhibitor reacts with an adjacent site and not the catalytic site, but alters the enzyme in such a way that it loses its catalytic property, e.g. acetazolamide on carbonic anhydrase.

3. Ion channels

Drugs can affect ion channels either through specific receptors or by directly binding to the channel and affecting ion movement through it e.g. local anesthetics which physically obstruct voltage-sensitive Na+ channels, quinidine blocks myocardial Na+ channels.

4. Transporters/carriers

Several substrates are transported across membranes by binding to specific transporters/ carriers. Many drugs produce their action by directly interacting with the transporters/carriers to inhibit the ongoing physiological transport of metabolite/ ion.
For example, probenecid inhibits the active transport of organic acids (uric acid, penicillin) in renal tubules by interacting with organic anion transporter.

5. Receptors

A receptor is a macromolecule or binding site located on the surface or inside the effector cell that serves to recognize the signal molecule/drug and initiate the response to it, but itself it has no other function