PHARMACODYNAMICS- PRINCIPLES AND MECHANISMS OF DRUG ACTION

Principles of Drug Action

Drugs (except those gene based) do not impart new functions to any system, organ or cell; they only alter the pace of ongoing activity.

- Stimulation
- Depression
- Dual action
- Irritation
- Replacement
- Antimicrobial effects
- Modification of immune status

Principles of Drug Action

1. **Stimulation :**

✓ Increase in the activity of specialized cells is called stimulation

e.g. 1. Adrenaline stimulates heart.
2. Pilocarpine stimulates salivary glands.
3. Morphine stimulates vagus and CTZ
4. Picrotoxin stimulates CNS

✓ However, excessive stimulation is often followed by depression of that function

e.g. 1. High dose of picrotoxin, produce convulsions followed by coma and respiratory depression.
2. High dose of morphine depress the respiratory and cough centers

Principles of Drug Action

2.Depression:

✓ Decrease in the activity of specialized cells is called depression

✓ e.g. 1.Quinidine depresses myocardium.
2. Barbiturates depress CNS
3. Benzodiazepam depress CNS

3. Dual action:

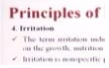
✓ Certain drugs stimulate one type of cells but depress the other

e.g. 1. Acetylcholine stimulates intestinal smooth muscle but depresses SA node in heart.
2. Morphine stimulates vomiting centre and depress respiratory centre

Principles of Drug Action

4. Irritation

- ✓ The term irritation indicates that a drug produce adverse effects on the growth, nutrition and morphology of living tissues
- ✓ Irritation is nonspecific phenomenon that can occurs in all tissues
- ✓ It produces changes in the cellular structure and can produce inflammation , corrosion and necrosis of cell
- ✓ The cellular changes produced are
  - Astringent effect
  - Dehydration
  - Cytotoxic action



Principles of Drug Action

5. Replacement:

✓This refers to the use of natural metabolites, hormones or their congeners in deficiency states.

e.g. 1. Levodopa in parkinsonism
2. Insulin in diabetes mellitus
3. Iron in anaemia.
4. Vitamins in vitamin deficiency
5. Calcium in osteoporosis

Principles of Drug Action

6. Antimicrobial effects

- ✓ Drugs are used for prevention, arrest and eradication of infections they act specifically on the causative organisms

e.g. Antibiotics like penicillin, chloroquine, zidovudine, cyclophosphamide etc.

7. Modification of immune status

- ✓ Vaccines, sera and certain other agents (Levamisole, corticosteroids) act by altering (enhancing or depressing) th immune status

Principles of Drug Action

Process	Drug	Site
✓Stimulation	Adrenaline	Heart
✓Depression	Morphine, Barbiturate, Alcohol	CNS
✓Replacement	Hormones	Endocrine System
✓Irritation	Bitters, Purgatives	GIT
✓Cytotoxic	Antimicrobials Anti cancer drugs	Parasitic cell

Mechanism of Drug action

The mechanism of drug action has been classified into

1. **Non receptor mediated**
2. **Receptor mediated**

Non receptor mediated is further classified into

a. Physical action
b. Chemical action
c. Action through Enzymes
d. Action through Ion channels
e. Action through Transporters

In receptor mediated Drug action

a. Receptors

Non Receptor Mediated-Physical Action

Osmolality

- Osmotic diuretics like mannitol

Adsorption

- Kaolin and activated charcoal used in diarrhoea

Soothing-demulcent

- Syrups as pharyngeal demulcents used in cough

Radioactivity

- ^{131}I in treatment of hyperthyroidism

Non Receptor Mediated-Chemical action

b. Chemical action:

- Antacids used in treatment of peptic ulcer
- Pot. Permanganate as oxidizing property
- Chelating agents (EDTA)as chelation of heavy metals.

c. Enzymes

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

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

Non Receptor Mediated- Enzymes

Enzymes (Contd..)

1. Enzyme stimulation:

✓ Several enzymes are stimulated through receptors and second messengers.

e.g. Adrenaline stimulates adenylyl cyclase

2. **Enzyme inhibition:**

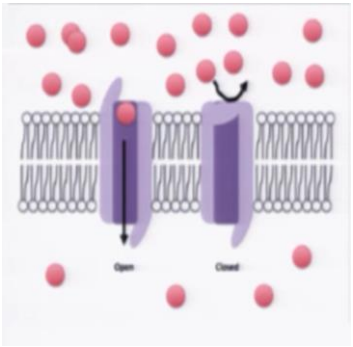
✓Occurs commonly with drugs and is either nonspecific

e.g. 1. Inhibition of cholinesterase by physostigmine

2. Inhibition of carbonic anhydrase by acetazolamide

Non Receptor Mediated- Ion channels

Drugs	Ion channel
Quinidine blocks	Myocardial Na+ channels.
Nifedipine blocks	Ca+ channels.
Nicorandil opens	ATP-sensitive K+ channels.
Sulfonylurea inhibit	K+ channels.
Amiloride inhibits	Renal epithelialNa+ channels
Phenytoin inhibits	Na+ channel.
Ethosuximide Block	T-type of Ca2+ channels
Local Anaesthetics inhibits	Na+ channel.



Non Receptor Mediated- Transporter