

General Pharmacology

Introduction to Pharmacology

Definition of Pharmacology

- Pharmacology is the branch of science that deals with the study of drugs, including their origin, nature, properties, actions, and effects on living organisms.
- It is primarily divided into two major branches:
 - **Pharmacodynamics** – What the drug does to the body (mechanism of action, therapeutic effect).
 - **Pharmacokinetics** – What the body does to the drug (absorption, distribution, metabolism, excretion).
- Pharmacology helps to understand the interaction between drugs and biological systems, guiding therapeutic applications and safety considerations.

Pharmacokinetics (PK)

- Pharmacokinetics is the study of what the body does to the drug.
- It involves the movement of drugs through the body and is typically divided into four key processes:
 1. **Absorption**
 2. **Distribution**
 3. **Metabolism (Biotransformation)**
 4. **Excretion**
- These processes determine the onset, intensity, and duration of a drug's action.

Historical Landmarks in Pharmacology

- Pharmacology has evolved from traditional herbal remedies to a highly scientific discipline.
- Here are important historical milestones:

1. Ancient Era:

- Early use of medicinal plants and minerals in civilizations such as Egypt, India (Ayurveda), China (Traditional Chinese Medicine), and Greece.

2. Dioscorides (1st Century):

- Authored *De Materia Medica*, cataloging medicinal substances from nature.

3. Paracelsus (16th Century):

- Introduced the principle "the dose makes the poison," emphasizing dose-response relationships.

4. 18th–19th Century:

- Isolation of active principles like morphine (from opium), quinine (from cinchona bark), and digitalis (from foxglove).

5. 20th Century:

- Discovery of antibiotics (e.g., penicillin by Alexander Fleming in 1928).
- Development of vaccines, anesthetics, and chemotherapeutic agents.
- Establishment of pharmacology as an experimental and clinical science.

6. Modern Era:

- Introduction of biotechnology, genetic engineering, targeted therapy, and pharmacogenomics.

Scope of Pharmacology

- Pharmacology intersects with multiple disciplines:
 - **Pharmacognosy:** Study of drugs derived from natural sources (plants, animals, minerals).
 - **Pharmaceutics:** Formulation and dispensing of drugs.
 - **Pharmacokinetics and Pharmacodynamics:** Essential sub-disciplines focusing on how the body handles drugs and how drugs act on the body.
 - **Toxicology:** Study of harmful effects of chemicals on living organisms.
 - **Clinical Pharmacology:** Application of pharmacological principles in the clinical setting.
 - **Pharmacovigilance:** Monitoring and evaluating drug safety post-marketing.
- The ultimate scope is to improve the use of drugs to optimize therapeutic outcomes and minimize adverse effects.

Importance:

- Development of safer and more effective drugs.
- Rational and evidence-based drug therapy.
- Regulation and monitoring of drug use.

Nature of Drugs

Definition of a Drug:

- A drug is any substance (natural or synthetic) that, when administered to a living organism, produces a biological effect.
- Drugs are used for diagnosis, prevention, treatment, or cure of diseases.

Chemical Nature of Drugs

1. Organic vs. Inorganic

- **Organic:** Most drugs are organic compounds (carbon-based), often containing nitrogen, oxygen, sulfur.
- **Inorganic:** Some drugs are made of metal ions or salts (e.g., lithium carbonate, magnesium sulfate).

2. Acids and Bases

- Most drugs are weak acids or weak bases.
- Their ionization affects absorption, distribution, and excretion.
- Ionized (charged) drugs are water-soluble but poorly lipid-soluble → poor absorption.
- Non-ionized (uncharged) drugs are lipid-soluble → better absorption.

3. Physical States

- Drugs may exist as:
 - **Solids:** Tablets, capsules, powders.
 - **Liquids:** Syrups, emulsions.
 - **Gases or volatile liquids:** Anesthetics like nitrous oxide.

4. Stereoisomerism

- Some drugs have optical isomers (enantiomers) with different biological activities.
- Example: L-isomer of propranolol is active; D-isomer is less active.

5. Prodrugs

- Inactive compounds that become active after metabolic conversion inside the body.
- Example: Enalapril (inactive) → Enalaprilat (active).



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