Pharmacodynamics: How Drugs Affect the Body

Mechanisms of Drug Action

Samar Hunaiti

Introduction to Pharmacodynamics

- Definition: Pharmacodynamics is the study of how drugs exert their effects on the body, including:
  - mechanisms of action
  - drug-receptor interactions
- Importance: Understanding pharmacodynamics helps predict the effects of a drug
  - at different doses
  - in different patients

Drug-Receptor Interactions

- Definition: Drugs interact with receptors on or within cells to exert their effects.
- Receptor: A protein that binds to a drug to initiate a biological response.
- Affinity: The strength of the drug-receptor binding.
- Efficacy: The ability of a drug to produce a desired effect once bound to a receptor.

Types of Receptors

- Ion Channel Receptors: E.g., GABA, nicotinic receptors.
- G-protein Coupled Receptors (GPCRs): E.g., adrenergic receptors.
- Enzyme-linked Receptors: E.g., insulin receptors.
- Intracellular Receptors: E.g., steroid hormone receptors.
- Example: How morphine (a GPCR agonist) binds to opioid receptors to relieve pain.

Agonists, Antagonists, and Partial Agonists

- Agonist: A drug that binds to a receptor and activates it (e.g., adrenaline).
- Antagonist: A drug that binds to a receptor but does not activate it, blocking agonist action (e.g., beta-blockers).
- Partial Agonist: A drug that binds and partially activates a receptor (e.g., buprenorphine).

Dose-Response Relationship

- Definition: The relationship between the drug dose and the magnitude of the drug's effect.
- Threshold dose: The smallest dose that produces an effect.
- Maximum efficacy: The greatest effect a drug can produce, regardless of dose.
- Potency: The amount of drug needed to produce a given effect.

Therapeutic Window and Index

- Therapeutic Window: The range of drug doses that produces a therapeutic response without causing significant adverse effects.
- Therapeutic Index (TI): The ratio between the toxic dose and the therapeutic dose of a drug.
- Wide TI: Safe drug (e.g., penicillin).
- Narrow TI: Narrow safety margin (e.g., warfarin).

Pharmacodynamic Variability

- Patient-Specific Factors:Age, genetics, disease state, and tolerance.
- Drug Interactions:
  - Synergistic effects (when drugs enhance each other).
  - Antagonistic effects (when drugs oppose each other).

Examples of Pharmacodynamic

- Concepts in Clinical Practice
- Example 1: Antihypertensives (beta-blockers) decrease blood pressure by blocking adrenergic receptors.
- Example 2: Anticoagulants (warfarin) inhibit vitamin K-dependent clotting factors.
- Example 3: Insulin binds to receptors on muscle and fat cells to facilitate glucose uptake.

Conclusion

- Summary: Pharmacodynamics explains how drugs exert their effects through receptor binding, efficacy, and potency.
- Final Thought: Understanding pharmacodynamics helps optimize drug therapy for individualized patient care.

Take home message

Pharmacodynamics: is how drugs affect the body via diverse mechanisms of drug action

Introduction to Pharmacology

- Register your attendance with your university number
- Make sure that the settings of your phone allow tracking location

Go to settings > privacy> location> services> make sure that location services is ON