الجامعة التقنية الشمالية
كلية التقنيات الصحية و الطبية الدور
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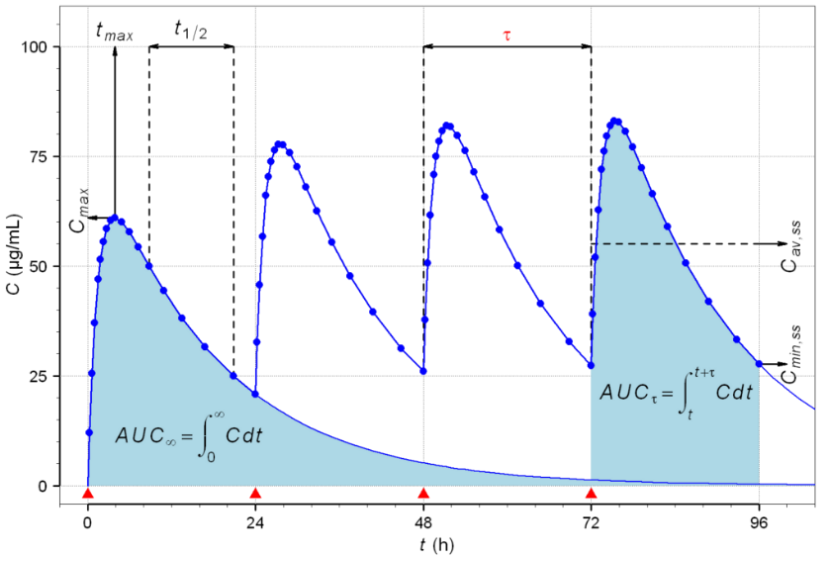
دوائـــــيات

Pharmacology

Pharmacology is the science of drugs and medications, including a substance's origin, composition, pharmacokinetics, pharmacodynamics, therapeutic use, and toxicology. More specifically, it is the study of the interactions that occur between a living organism and chemicals that affect normal or abnormal biochemical function. If substances have medicinal properties, they are considered pharmaceuticals.

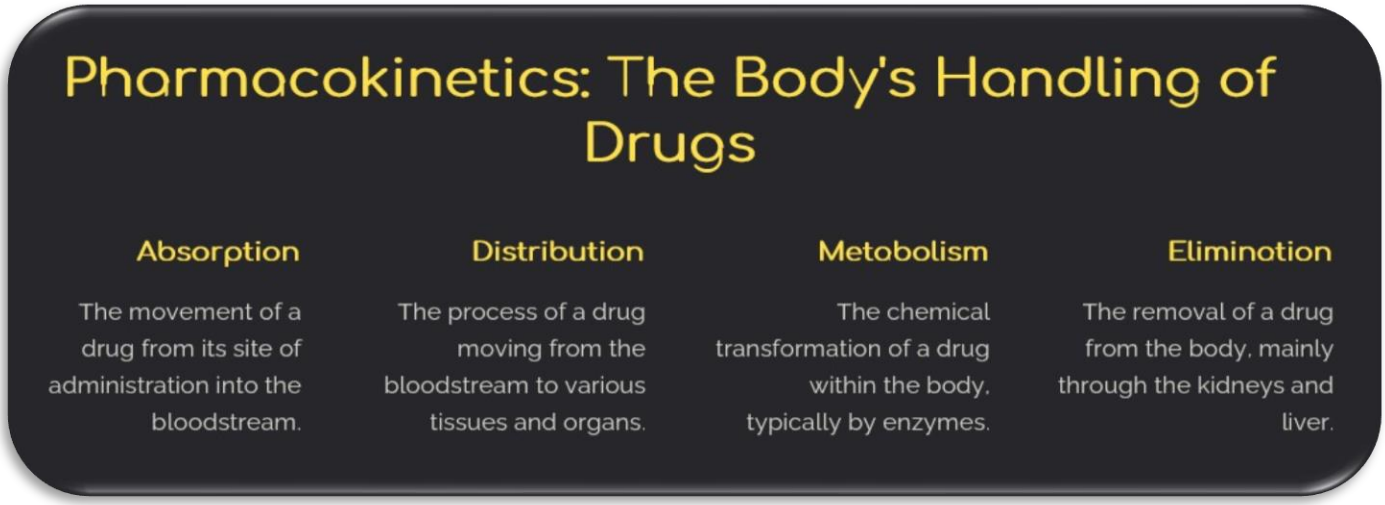
The two main areas of pharmacology are pharmacodynamics and pharmacokinetics. Pharmacodynamics studies the effects of a drug on biological systems, and pharmacokinetics studies the effects of biological systems on a drug. In broad terms, pharmacodynamics discusses the chemicals with biological receptors, and pharmacokinetics discusses the absorption, distribution, metabolism, and excretion (ADME) of chemicals from the biological systems.

➢ Pharmacokinetics



Pharmacokinetics sometimes abbreviated as PK, is a branch of pharmacology dedicated to describing how the body affects a specific substance after administration.[1] The substances of interest include any chemical xenobiotic such as pharmaceutical drugs, pesticides, food additives, cosmetics, etc. It attempts to analyze chemical metabolism and to discover the fate of a chemical from the moment that it is administered up to the point at which it is completely eliminated from the body.

Pharmacokinetics is the study of how an organism affects the drug, whereas pharmacodynamics (PD) is the study of how the drug affects the organism. Both together influence dosing, benefit, and adverse effects, as seen in PK/PD models.



- **Pharmacodynamics**

Pharmacodynamics (PD) is the study of the biochemical and physiologic effects of drugs (especially pharmaceutical drugs). The effects can include those manifested within animals (including humans), microorganisms, or combinations of organisms (for example, infection).

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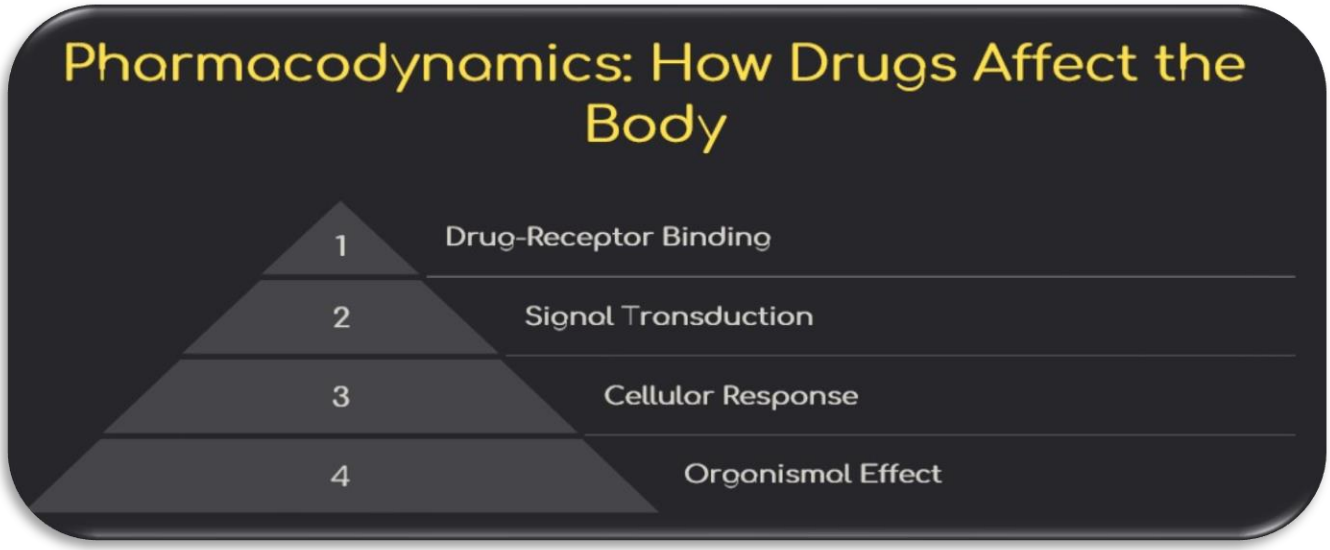
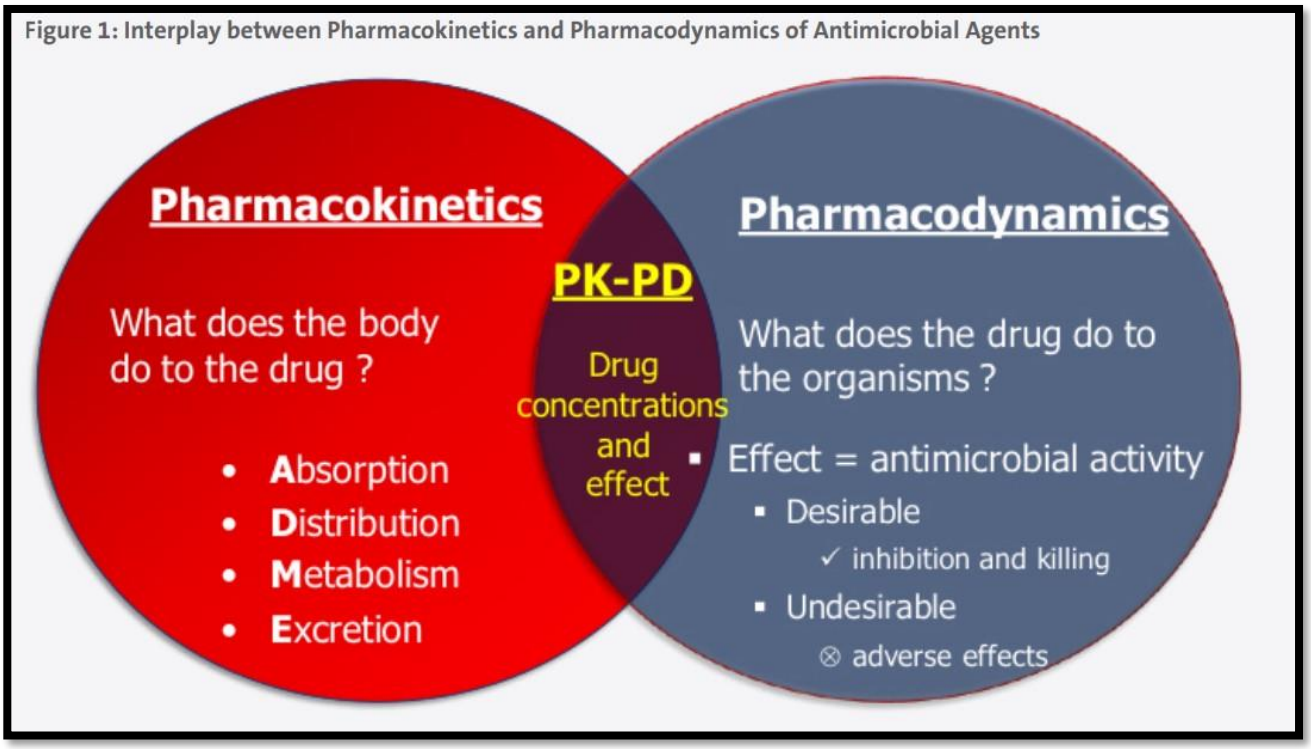
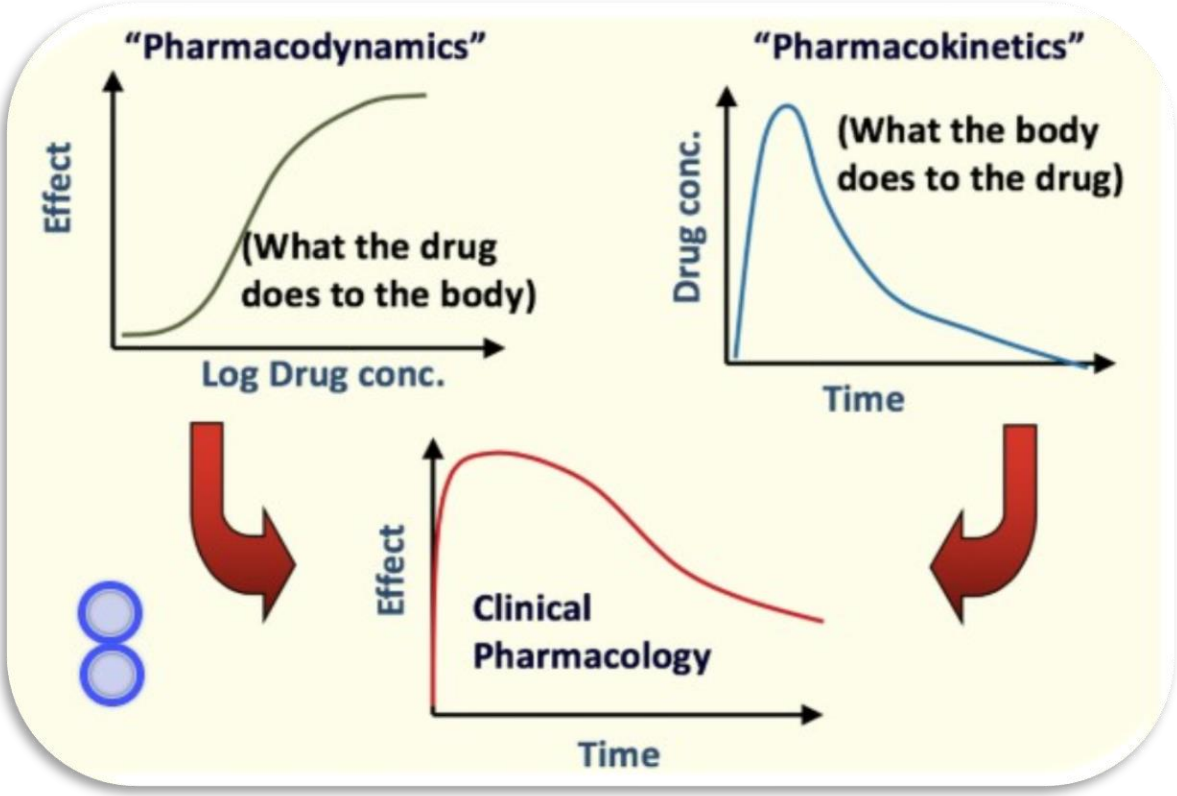


Figure 1: Interplay between Pharmacokinetics and Pharmacodynamics of Antimicrobial Agents



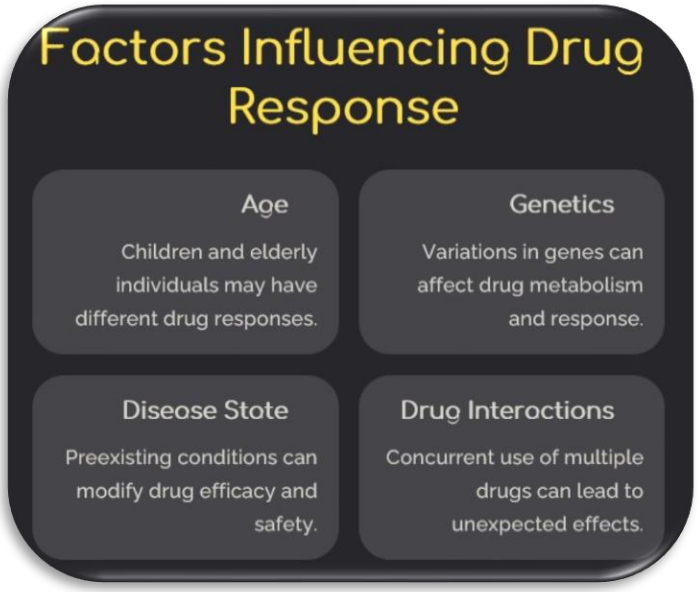


Dose (biochemistry)

A dose is a measured quantity of a medicine, nutrient, or pathogen that is delivered as a unit. The greater the quantity delivered, the larger the dose. Doses are most commonly measured for compounds in medicine. The term is usually applied to the quantity of a drug or other agent administered for therapeutic purposes, but may be used to describe any case where a substance is introduced to the body. In nutrition, the term is usually applied to how much of a specific nutrient is in a person's diet or in a particular food, meal, or dietary supplement. For bacterial or viral agents, dose typically refers to the amount of the pathogen required to infect a host.

In clinical pharmacology, dose refers to the amount of drug administered to a person, and dosage is a fuller description that includes not only the dose (e.g., "500 mg") but also the frequency and duration of the treatment (e.g., "twice a day for one week"). Exposure means the time-dependent concentration (often in the circulatory blood or plasma) or concentration-derived parameters such as AUC (area under the concentration curve) and Cmax (peak level of the concentration curve) of the drug after its administration[citation needed]. This is in contrast to their interchangeable use in other fields.

Factors affecting dose



A 'dose' of any chemical or biological agent (active ingredient) has several factors which are critical to its effectiveness. The first is concentration, that is, how much of the agent is being administered to the body at once. Under-dosing is a common problem in pharmacy, as predicting an average dose that is effective for all individuals is extremely challenging because body weight and size impacts how the dose acts within the body.

Another factor is the duration of exposure. Some drugs or supplements have a slow-release feature in which portions of the medication are metabolized at different times, which changes the impacts the active ingredients have on the body. Some substances are meant to be taken in small doses over large periods of time to maintain a constant level in the body, while others are meant to have a large impact once and be expelled from the body after its work is done. It's entirely dependent on the function of the drug or supplement.

The route of administration is important as well. Whether a drug is ingested orally, injected into a muscle or vein, absorbed through a mucous membrane, or any of the other types of administration routes, affects how quickly the substance will be metabolized by the body and thus effects the concentration of the active ingredient(s).

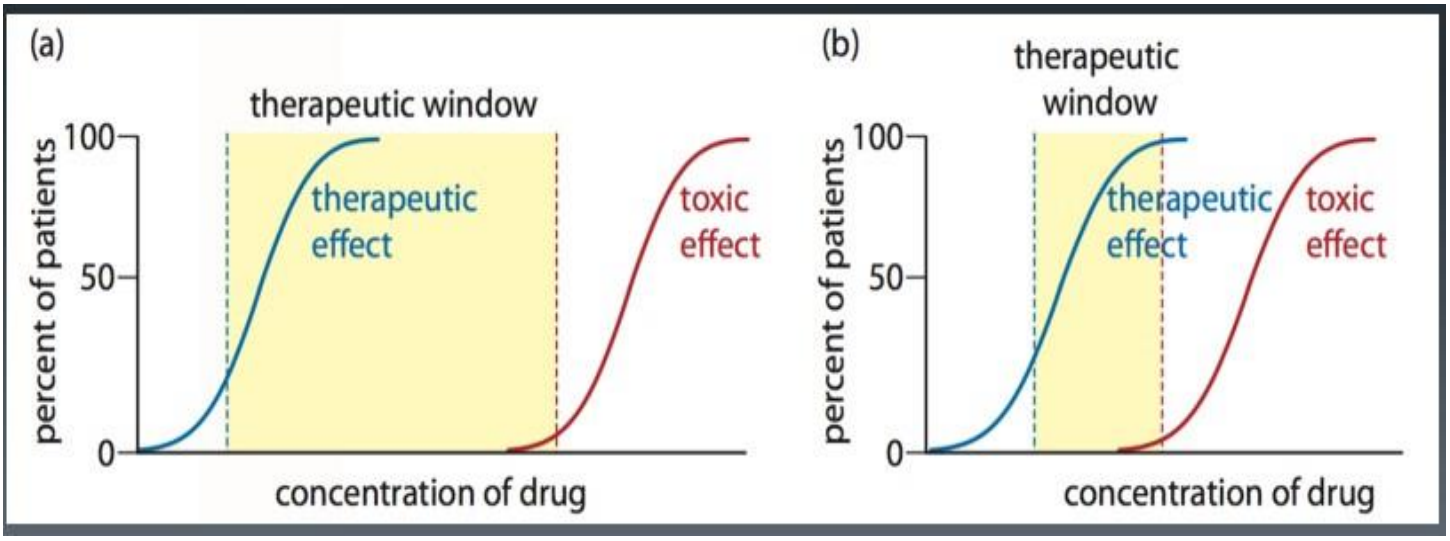
The Therapeutic Index

The therapeutic index (TI; also referred to as therapeutic ratio) is a quantitative measurement of the relative safety of a drug with regard to risk of overdose. It is a comparison of the amount of a therapeutic agent that causes toxicity to the amount that causes the therapeutic effect.

The related terms therapeutic window or safety window refer to a range of doses optimized between efficacy and toxicity, achieving the greatest therapeutic benefit without resulting in unacceptable side-effects or toxicity.

Classically, for clinical indications of an approved drug, TI refers to the ratio of the dose of the drug that causes adverse effects at an incidence/severity not compatible with the targeted indication (e.g. toxic dose in 50% of subjects, TD50) to the dose that leads to the desired pharmacological effect (e.g. efficacious dose in 50% of subjects, ED50). In contrast, in a drug development setting TI is calculated based on plasma exposure levels.

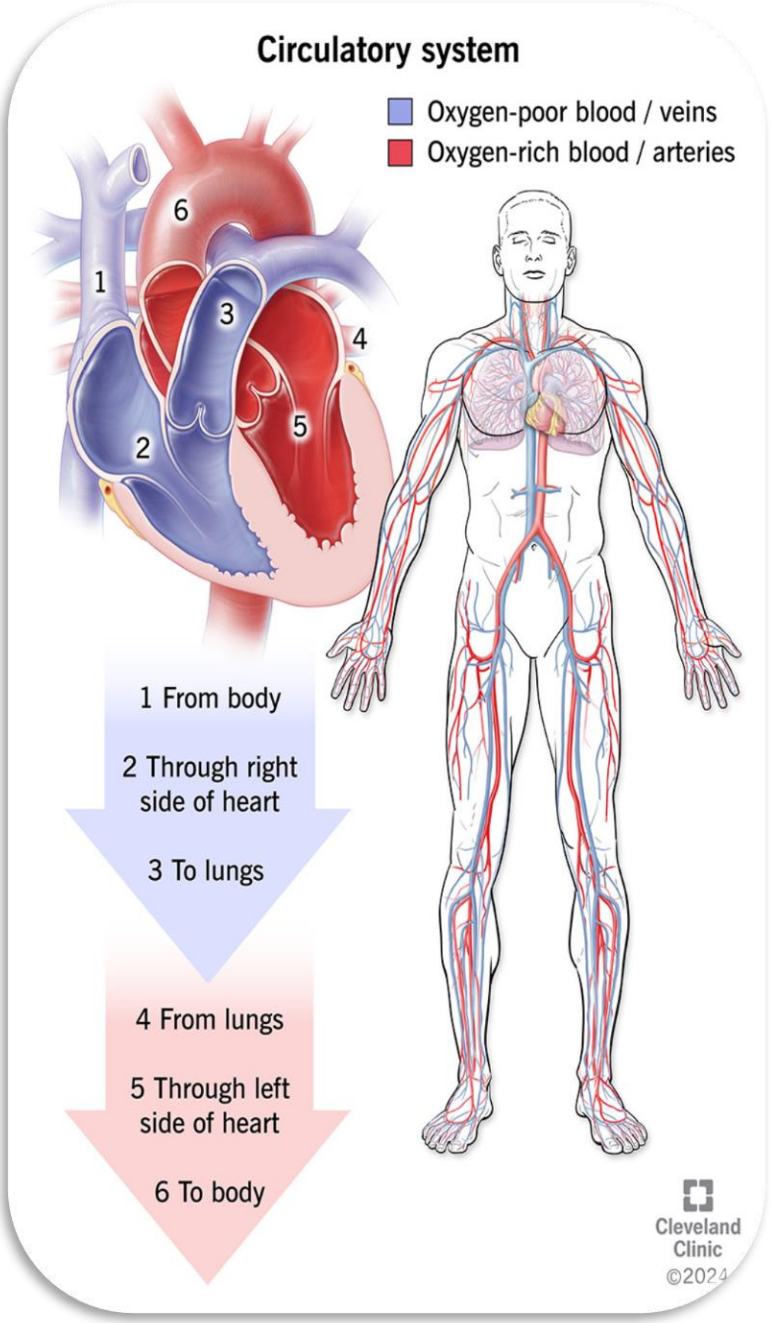
For many drugs, severe toxicities in humans occur at sublethal doses, which limit their maximum dose. A higher safety-based therapeutic index is preferable instead of a lower one; an individual would have to take a much higher dose of a drug to reach the lethal threshold than the dose taken to induce the therapeutic effect of the drug. However, a lower efficacy-based therapeutic index is preferable instead of a higher one; an individual would have to take a higher dose of a drug to reach the toxic threshold than the dose taken to induce the therapeutic effect of the drug.



If a drug has a high (or wide) therapeutic index, this means that there is a large difference between the dose of the drug that causes a therapeutic effect compared with the dose that causes a toxic effect.

Circulatory system

the circulatory system is a system of organs that includes the heart, blood vessels, and blood which is circulated throughout the body.



It includes the cardiovascular system, or vascular system, that consists of the heart and blood vessels (from Greek kardia meaning heart, and Latin vascula meaning vessels). The circulatory system has two divisions, a systemic circulation or circuit, and a pulmonary circulation or circuit

- The cardiovascular system provides blood supply throughout the body
- Responding to various stimuli can control the velocity and amount of blood carried through the vessels.
- The cardiovascular system comprises the heart, arteries, veins, and capillaries.
- The heart and vessels work intricately to provide adequate blood flow to all body parts.

Drugs Acting on the Cardiovascular System

The cardiovascular system is essential for maintaining homeostasis, delivering oxygen, and removing metabolic waste. Various pharmacological agents influence cardiovascular function to treat conditions like ischemia, arrhythmias, hypertension, and clotting disorders. This lecture explores the major classes of drugs acting on the cardiovascular system.

1. Antianginal Agents

Definition: Antianginal drugs are used to relieve or prevent angina pectoris, a symptom of myocardial ischemia due to reduced coronary blood flow.

Classes:

- **Nitrates** (e.g., Nitroglycerin, Isosorbide dinitrate): Act by releasing nitric oxide (NO), which induces vasodilation by increasing cGMP levels.
- **Beta-blockers** (e.g., Propranolol, Metoprolol): Reduce myocardial oxygen demand by decreasing heart rate and contractility.
- **Calcium Channel Blockers** (e.g., Amlodipine, Verapamil, Diltiazem): Inhibit calcium influx in vascular smooth muscle, causing vasodilation.

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2. Antiarrhythmic Agents

Definition: Drugs that modify abnormal heart rhythms by affecting ion channels or autonomic function.

Classes (Vaughan-Williams Classification):

- **Class I (Sodium Channel Blockers)**: Reduce conduction velocity (e.g., Lidocaine, Quinidine).
- **Class II (Beta-blockers)**: Decrease sympathetic activity (e.g., Atenolol, Esmolol).
- **Class III (Potassium Channel Blockers)**: Prolong repolarization (e.g., Amiodarone, Sotalol).
- **Class IV (Calcium Channel Blockers)**: Decrease AV nodal conduction (e.g., Verapamil, Diltiazem).

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3. Drugs Used in Congestive Heart Failure (CHF)

Definition: CHF results from the heart's inability to pump blood efficiently, leading to fluid retention and reduced cardiac output.

Classes:

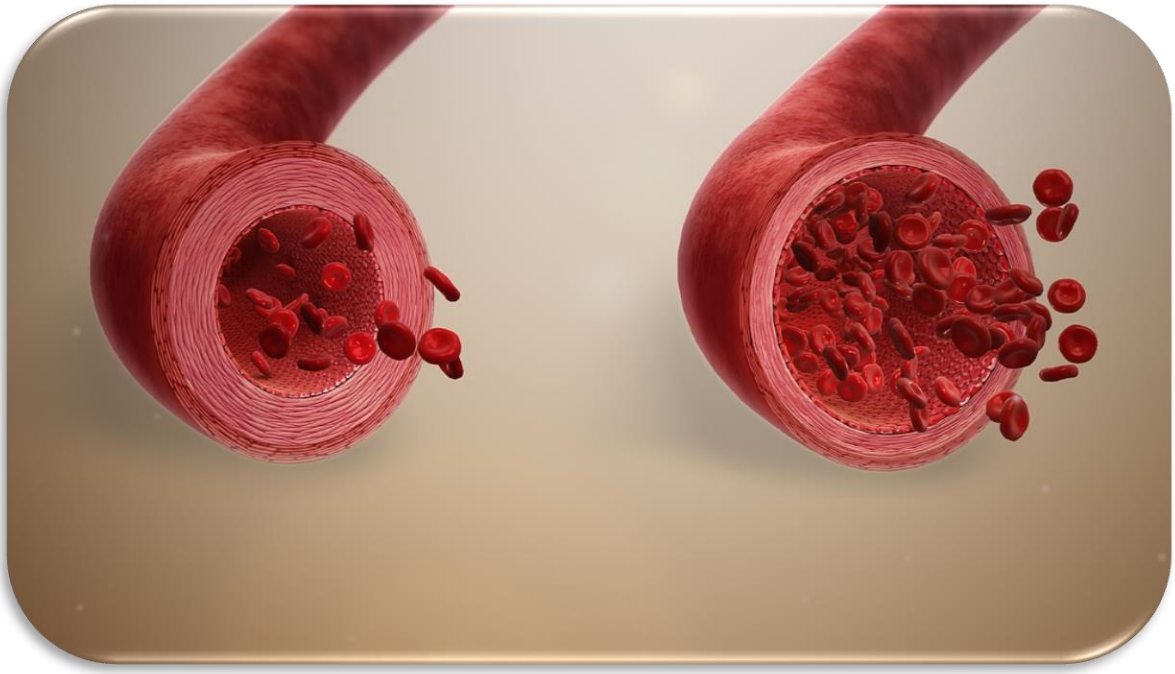
- **Cardiac Glycosides (e.g., Digoxin)**: Increase myocardial contractility by inhibiting Na+/K+-ATPase.
- **ACE Inhibitors (e.g., Enalapril, Lisinopril)**: Reduce afterload by blocking angiotensin II formation.
- **Beta-blockers (e.g., Carvedilol, Bisoprolol)**: Improve survival by reducing cardiac workload.

4. Vasodilators

Definition: Agents that cause blood vessel dilation, reducing vascular resistance and blood pressure.

Classes:

- **Direct Vasodilators (e.g., Hydralazine, Minoxidil)**: Act directly on vascular smooth muscle.
- **ACE Inhibitors (e.g., Ramipril, Captopril)**: Inhibit angiotensin II production, reducing vasoconstriction.
- **Nitrates (e.g., Isosorbide mononitrate, Sodium nitroprusside)**: Release NO, enhancing cGMP-mediated relaxation.



5. Antihypertensive Agents

Definition: Drugs used to lower blood pressure and prevent complications such as stroke and heart attack.

Classes:

- **Beta-blockers (e.g., Metoprolol, Atenolol)**: Lower cardiac output and renin secretion.
- **ACE Inhibitors (e.g., Enalapril, Lisinopril)**: Block angiotensin II effects.
- **Calcium Channel Blockers (e.g., Amlodipine, Diltiazem)**: Relax vascular smooth muscle.

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6. Hemopoietic Agents

Definition: Drugs that stimulate blood cell production, used in anemia and bone marrow suppression.

Classes:

- **Erythropoiesis-Stimulating Agents (e.g., Erythropoietin, Darbepoetin alfa)**: Stimulate red blood cell production.
- **Iron Supplements (e.g., Ferrous sulfate, Iron dextran)**: Essential for hemoglobin synthesis.
- **Folic Acid & Vitamin B12 (e.g., Cyanocobalamin, Leucovorin)**: Required for DNA synthesis in erythropoiesis.

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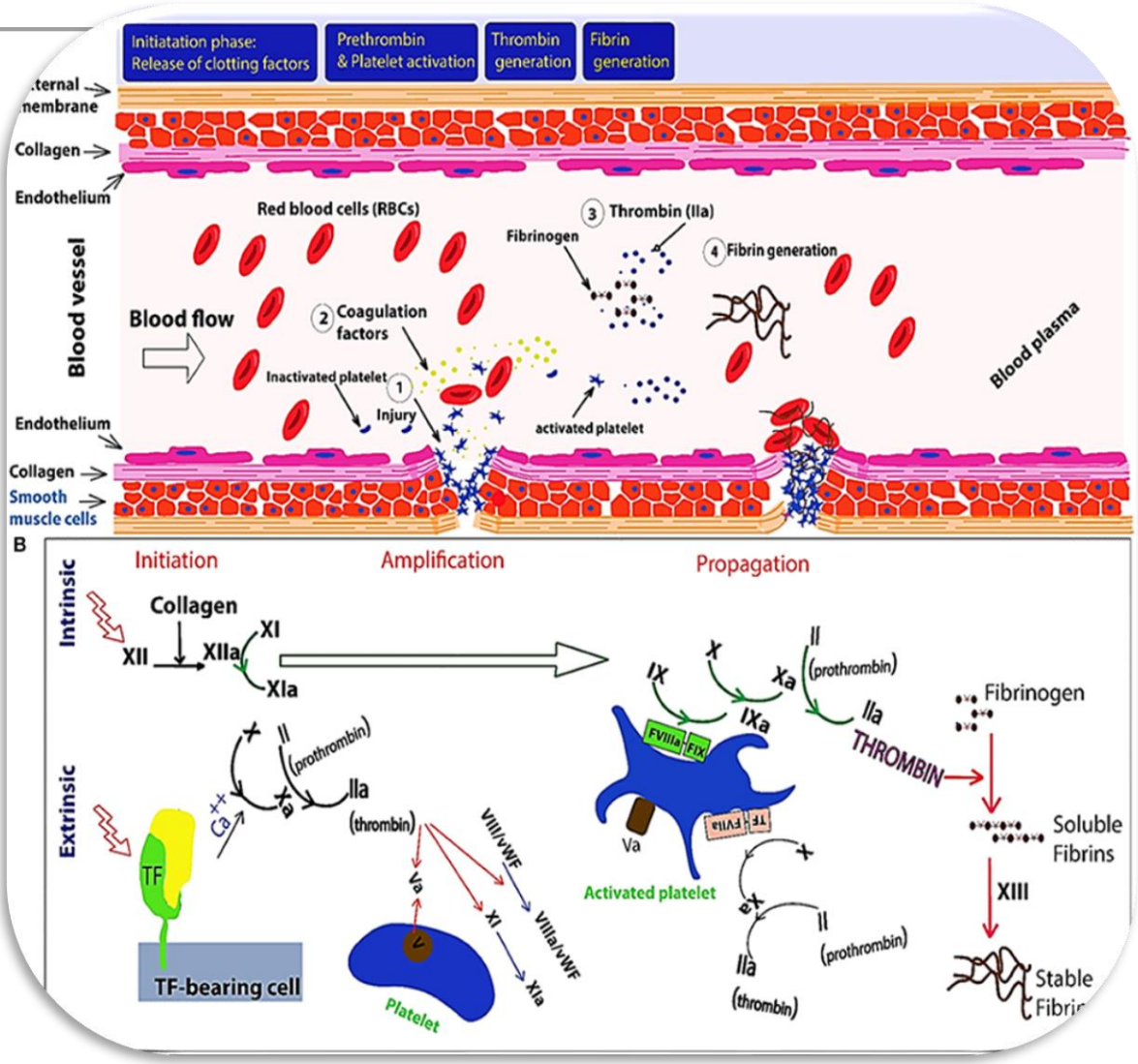
7. Anticlotting Agents

Definition: Drugs that prevent thrombosis by inhibiting platelet function or the coagulation cascade.

Classes:

- **Antiplatelet Agents (e.g., Aspirin, Clopidogrel)**: Inhibit platelet aggregation.

- **Anticoagulants (e.g., Heparin, Warfarin, Dabigatran)**: Interfere with clotting factors.
- **Thrombolytics (e.g., Alteplase, Streptokinase)**: Dissolve existing clots.



8. Anti-haemorrhagic Agents

Definition: Drugs that promote clot formation and reduce bleeding.

Classes:

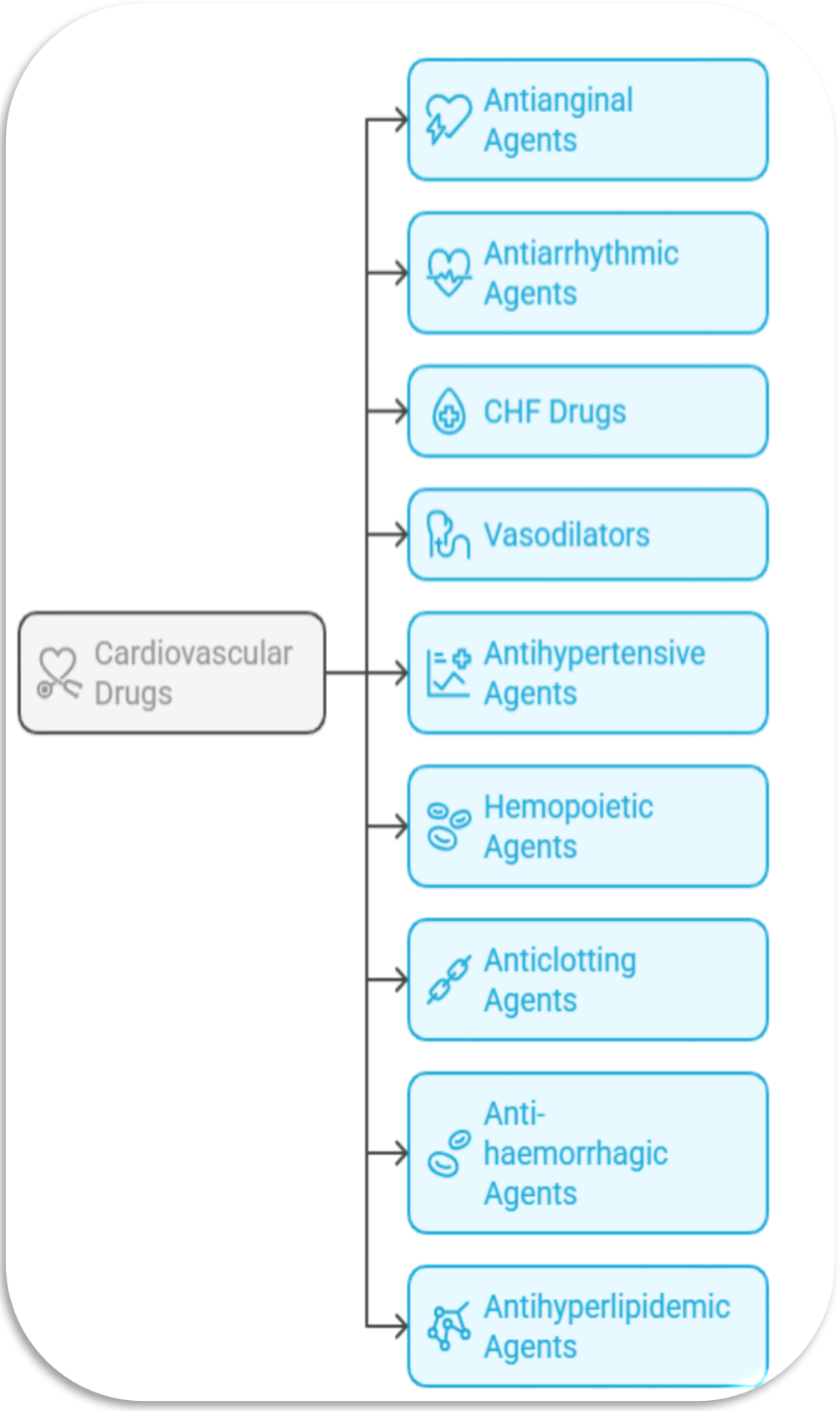
- **Clotting Factor Replacements (e.g., Factor VIII, Factor IX for hemophilia)**.
- **Fibrinolysis Inhibitors (e.g., Tranexamic acid, Aminocaproic acid)**.
- **Vitamin K (e.g., Phytomenadione)**: Essential for synthesis of clotting factors.

9. Antihyperlipidemic Agents

Definition: Drugs that lower lipid levels to prevent atherosclerosis and cardiovascular diseases.

Classes:

- **Statins (e.g., Atorvastatin, Simvastatin)**: Inhibit HMG-CoA reductase to reduce cholesterol synthesis.
- **Fibrates (e.g., Fenofibrate, Gemfibrozil)**: Enhance fatty acid oxidation.
- **Bile Acid Sequestrants (e.g., Cholestyramine, Colestipol)**: Prevent bile acid reabsorption.



Autonomic Nervous System (ANS)

Introduction

The ANS is responsible for involuntary physiological functions and is divided into two main branches: the sympathetic and parasympathetic nervous systems. Understanding how drugs interact with these systems is crucial for therapeutic interventions in various medical conditions.

focus will be on four categories of drugs: **cholinergic agonists, cholinergic antagonists, adrenergic agonists, and adrenergic antagonists.**

I. Cholinergic Agonists

Cholinergic agonists, are drugs that mimic the action of acetylcholine, the primary neurotransmitter of the parasympathetic nervous system.

Mechanism of Action:

These drugs bind to cholinergic receptors, either muscarinic or nicotinic, to activate physiological functions associated with the parasympathetic system.

Types of Cholinergic Agonists:

a. Direct-acting agonists: These drugs bind directly to receptors.
b. Indirect-acting agonists : These drugs inhibit the enzyme acetylcholinesterase, increasing acetylcholine levels.

Clinical Uses:

- Treatment of glaucoma
- Management of myasthenia gravis
- Reversal of neuromuscular blockade after surgery

Side Effects:

- Excessive salivation, lacrimation, urination, diarrhea, gastrointestinal distress, emesis (SLUDGE symptoms)
- Bradycardia and hypotension

II. Cholinergic Antagonists

Cholinergic antagonists, or anticholinergics, inhibit the action of acetylcholine.

Mechanism of Action:

- These drugs block muscarinic or nicotinic receptors, inhibiting parasympathetic nerve impulses.

Types of Cholinergic Antagonists:

a. **Muscarinic antagonists:** Atropine and scopolamine

b. **Nicotinic antagonists:** Used less commonly, include drugs like pancuronium for neuromuscular blockade.

Clinical Uses:

- Treatment of bradycardia
- Reduction of salivary and respiratory secretions
- Management of motion sickness
- Treatment of overactive bladder

Side Effects:

- Dry mouth, constipation, urinary retention, blurred vision, and confusion
- Elevated body temperature (due to decreased sweating)

III. Adrenergic Agonists

Adrenergic agonists, simulate the actions of norepinephrine and epinephrine, neurotransmitters of the sympathetic nervous system.

- **Mechanism of Action:**
  - These drugs bind to adrenergic receptors (alpha or beta) to stimulate sympathetic nervous responses.

- **Types of Adrenergic Agonists:**

a. **Direct-acting agonists**

b. **Indirect-acting agonists**

- **Clinical Uses:**
    - Asthma and COPD management
    - Shock and cardiac arrest support
    - Nasal decongestion
- **Side Effects:**
    - Increased heart rate, hypertension, anxiety, and tremors

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IV. Adrenergic Antagonists

Adrenergic antagonists, or sympatholytics, inhibit the actions of norepinephrine and epinephrine.

- **Mechanism of Action:**
    - These drugs block adrenergic receptors, diminishing sympathetic nervous activity.
- **Types of Adrenergic Antagonists:**

a. **Alpha blockers**

b. **Beta blockers**

- **Clinical Uses:**
    - Hypertension and heart failure management
    - Benign prostatic hyperplasia
    - Anxiety and migraine prophylaxis
- **Side Effects:**
    - Bradycardia, hypotension, fatigue, and potential respiratory issues in asthmatics

Lecture on Drugs Affecting the Central Nervous System

Introduction The central nervous system (CNS) is the primary control center of the body, encompassing the brain and spinal cord. It regulates bodily functions, processes sensory information, and facilitates cognitive abilities. Drugs affecting the CNS influence neurotransmission, altering mental states, behavior, and motor functions. These drugs can be categorized based on their therapeutic effects, including anxiolytics, hypnotics, analgesics, antiseizure drugs, antiparkinsonian agents, antipsychotics, antidepressants, muscle relaxants, and drugs of abuse.

I. Anxiolytic and Hypnotic Drugs

Definition: Anxiolytics and hypnotics are medications used to reduce anxiety and induce sleep, respectively.

Types:

1. **Benzodiazepines** (e.g., Diazepam, Lorazepam) - Enhance GABAergic inhibition, used for anxiety, insomnia, and seizures.
2. **Barbiturates** (e.g., Phenobarbital) - Less commonly used due to high risk of dependence and overdose.
3. **Non-benzodiazepine Hypnotics** (e.g., Zolpidem, Zaleplon) - Selectively act on GABA receptors to promote sleep with fewer side effects.

Clinical Uses:

- Treatment of **generalized anxiety disorder (GAD)**
- **Insomnia management**
- **Seizure control**

Side Effects:

- Drowsiness, confusion, dependence, withdrawal symptoms

II. Analgesic Drugs (Opioids)

Definition: Opioid analgesics relieve pain by acting on opioid receptors in the brain and spinal cord.

Types:

1. **Strong Opioids** (e.g., Morphine, Fentanyl) - Used for severe pain relief.
2. **Moderate Opioids** (e.g., Codeine, Hydrocodone) - Used for moderate pain relief.
3. **Mixed Agonist-Antagonists** (e.g., Buprenorphine) - Used for pain management and opioid dependence treatment.

Clinical Uses:

- **Acute and chronic pain relief**
- **Anesthesia adjunct**
- **Palliative care**

Side Effects:

- Respiratory depression, constipation, tolerance, dependence

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III. Antiseizure Drugs

Definition: Antiseizure drugs prevent or reduce seizure activity by stabilizing neuronal excitability.

Types:

1. **Sodium Channel Blockers** (e.g., Phenytoin, Carbamazepine) - Reduce neuronal excitability.
2. **GABA Enhancers** (e.g., Valproic Acid, Benzodiazepines) - Increase inhibitory neurotransmission.
3. **Calcium Channel Modulators** (e.g., Ethosuximide) - Used for absence seizures.

Clinical Uses:

- **Epilepsy treatment**
- **Seizure prevention**

Side Effects:

- Sedation, dizziness, cognitive impairment

IV. Drugs for Parkinson's Disease

Definition: These drugs aim to restore dopamine balance in the brain, alleviating motor symptoms of Parkinson's disease.

Types:

1. **Dopamine Precursors** (e.g., Levodopa/Carbidopa) - Increase dopamine synthesis.
2. **Dopamine Agonists** (e.g., Ropinirole, Pramipexole) - Stimulate dopamine receptors.
3. **MAO-B Inhibitors** (e.g., Selegiline) - Prevent dopamine breakdown.

Clinical Uses:

- **Parkinson's disease symptom management**

Side Effects:

- Dyskinesia, nausea, hallucinations

V. Antipsychotic Agents

Definition: Antipsychotic drugs are used to manage schizophrenia and other psychotic disorders by modulating dopamine transmission.

Types:

1. **Typical Antipsychotics** (e.g., Haloperidol) - Primarily block dopamine D2 receptors.
2. **Atypical Antipsychotics** (e.g., Risperidone, Clozapine) - Block dopamine and serotonin receptors.

Clinical Uses:

- **Schizophrenia management**
- **Bipolar disorder treatment**

Side Effects:

- Extrapyramidal symptoms (EPS), weight gain, sedation

VI. Antidepressant Agents

Definition: Antidepressants enhance mood by affecting serotonin, norepinephrine, or dopamine levels.

Types:

1. **Selective Serotonin Reuptake Inhibitors (SSRIs)** (e.g., Fluoxetine, Sertraline) - Increase serotonin levels.
2. **Tricyclic Antidepressants (TCAs)** (e.g., Amitriptyline) - Affect multiple neurotransmitters.
3. **Monoamine Oxidase Inhibitors (MAOIs)** (e.g., Phenelzine) - Inhibit monoamine metabolism.

Clinical Uses:

- **Depression treatment**
- **Anxiety disorder management**

Side Effects:

- Sexual dysfunction, weight gain, withdrawal symptoms

VII. Muscle Relaxants

Definition: These drugs reduce muscle spasticity or spasms by acting on the CNS or neuromuscular junction.

Types:

1. **Centrally Acting Muscle Relaxants** (e.g., Baclofen, Diazepam) - Suppress spinal reflexes.
2. **Peripherally Acting Muscle Relaxants** (e.g., Dantrolene) - Reduce muscle contraction directly.

Clinical Uses:

- **Spasticity treatment (e.g., in multiple sclerosis, cerebral palsy)**
- **Muscle relaxation post-injury**

Side Effects:

- Drowsiness, muscle weakness, dizziness

VIII. Drugs of Abuse

Definition: These substances alter mood, perception, and behavior, often leading to addiction.

Types:

1. **Stimulants** (e.g., Cocaine, Methamphetamine) - Increase dopamine and norepinephrine.
2. **Depressants** (e.g., Alcohol, Benzodiazepines) - Enhance GABAergic activity.
3. **Hallucinogens** (e.g., LSD, Psilocybin) - Alter serotonin function.

Clinical Concerns:

- **Dependence and withdrawal symptoms**
- **Neurotoxicity and cognitive impairment**

Conclusion

Drugs affecting the CNS play essential roles in managing neurological and psychiatric disorders. Their mechanisms of action target neurotransmitter systems to alleviate symptoms and improve quality of life. However, these drugs must be used cautiously due to their potential side effects, dependency risks, and impact on cognitive and motor functions.

Introduction to Anesthetics

Anesthetics are drugs that induce a reversible loss of sensation or consciousness, primarily used in medical and surgical procedures to prevent pain and discomfort. They are classified into two main types: **general anesthetics**, which induce a state of unconsciousness, and **local anesthetics**, which block nerve transmission in specific areas of the body.

General Anesthetics

General anesthesia is a medically induced coma with loss of protective reflexes, typically achieved through the administration of inhaled or intravenous (IV) anesthetics. General anesthetics work by depressing the central nervous system (CNS), particularly the brain and spinal cord, resulting in unconsciousness, analgesia (pain relief), muscle relaxation, and loss of reflexes.

Inhaled General Anesthetics

Inhaled anesthetics are gases or volatile liquids administered through inhalation. They are commonly used in both induction and maintenance of anesthesia.

Common Inhaled Anesthetics:

1. **Nitrous Oxide (N2O):** A weak anesthetic but strong analgesic, often used in combination with other agents.
2. **Halothane:** Previously widely used, but now less common due to liver toxicity concerns.
3. **Isoflurane:** Commonly used due to its stability and minimal metabolic breakdown.
4. **Sevoflurane:** Preferred for pediatric anesthesia due to its rapid onset and minimal airway irritation.
5. **Desflurane:** Known for its rapid induction and recovery but requires specialized vaporizers.

Mechanism of Action:

- Enhance inhibitory neurotransmission via **GABA-A receptors**.
- Reduce excitatory neurotransmission through **NMDA receptor inhibition**.
- Decrease synaptic transmission in the CNS, leading to unconsciousness and immobility.

Advantages:

- Easily controllable depth of anesthesia.
- Rapid elimination via respiration.
- Suitable for long procedures.

Disadvantages:

- Potential for respiratory depression and cardiovascular effects.
- Risk of malignant hyperthermia in genetically predisposed patients.

Intravenous (IV) General Anesthetics

IV anesthetics are administered through a vein and are commonly used for rapid induction of anesthesia.

Common IV Anesthetics:

1. **Propofol:** The most widely used IV anesthetic; provides smooth induction and quick recovery.
2. **Thiopental (Barbiturate):** Ultra-short-acting; historically used but now less common.
3. **Etomidate:** Used for high-risk cardiac patients due to its minimal cardiovascular effects.
4. **Ketamine:** Produces dissociative anesthesia; preserves airway reflexes and provides analgesia.
5. **Midazolam (Benzodiazepine):** Used for preoperative sedation and induction.

Mechanism of Action:

- Propofol, thiopental, and etomidate **enhance GABA-A receptor activity**, leading to CNS depression.
- Ketamine **inhibits NMDA receptors**, causing dissociative anesthesia.

Advantages:

- Rapid induction (especially propofol and thiopental).
- Reduced airway irritation compared to inhaled agents.

Disadvantages:

- Risk of cardiovascular and respiratory depression.
- Some agents (e.g., propofol) require continuous infusion for maintenance.

Local Anesthesia

Local anesthetics block nerve conduction in a specific region without affecting consciousness. They are widely used for minor surgical procedures, dental procedures, and pain management.

Types of Local Anesthetics

1. **Amide-type local anesthetics:**
    - **Lidocaine:** Most commonly used; fast onset and moderate duration.
    - **Bupivacaine:** Long-acting; used for epidurals and nerve blocks.
    - **Ropivacaine:** Similar to bupivacaine but with lower toxicity.
2. **Ester-type local anesthetics:**
    - **Procaine:** Short-acting; historically used in dental procedures.
    - **Tetracaine:** Long-acting; used for spinal anesthesia.
    - **Cocaine:** Rarely used; has both anesthetic and vasoconstrictive properties.

Mechanism of Action:

- Local anesthetics **block sodium channels** in nerve membranes, preventing depolarization and the propagation of action potentials.

Methods of Administration:

- **Topical Application:** Applied directly to skin or mucous membranes (e.g., lidocaine gel, benzocaine spray).
- **Infiltration:** Injected into tissues for minor surgical procedures.
- **Nerve Blocks:** Injected near nerves to provide regional anesthesia (e.g., epidural, brachial plexus block).
- **Spinal Anesthesia:** Injected into the cerebrospinal fluid for lower body procedures.
- **Epidural Anesthesia:** Injected into the epidural space; commonly used in labor pain management.

Advantages of Local Anesthesia:

- Avoids systemic effects associated with general anesthesia.

- Provides targeted pain relief with minimal recovery time.
- Reduces the need for postoperative opioids.

Disadvantages of Local Anesthesia:

- Ineffective for large or deeply seated surgeries.
- Risk of systemic toxicity if injected into the bloodstream.
- Potential for nerve damage in rare cases.

Antibiotic

An antibiotic is a type of antimicrobial substance active against bacteria. It is the most important type of antibacterial agent for fighting bacterial infections, and antibiotic medications are widely used in the treatment and prevention of such infections.[1][2] They may either kill or inhibit the growth of bacteria. A limited number of antibiotics also possess antiprotozoal activity.[3][4] Antibiotics are not effective against viruses such as the ones which cause the common cold or influenza.[5] Drugs which inhibit growth of viruses are termed antiviral drugs or antivirals. Antibiotics are also not effective against fungi. Drugs which inhibit growth of fungi are called antifungal drugs.

Fast facts on antibiotics

- Alexander Fleming discovered penicillin, the first natural antibiotic, in 1928.
- Antibiotics cannot fight viral infections.
- Fleming predicted the rise of antibiotic resistance.
- Antibiotics either kill or slow the growth of bacteria.
- Side effects can include diarrhea, an upset stomach, and nausea.

Types of antibiotics

There are various antibiotics available and each comes with different brand names, depending on the manufacturer. Antibiotics are usually grouped together based on how they work. Each type of antibiotic only works against certain types of bacteria or parasites. This is why different antibiotics are used to treat different types of infection. The main types of antibiotics include:

- Penicillins - for example, phenoxymethylpenicillin.
- Cephalosporins - for example, cefaclor.

- Tetracyclines - for example, tetracycline.
- Aminoglycosides - for example, gentamicin.
- Macrolides - for example azithromycin .
- Clindamycin.
- Sulfonamides and trimethoprim - for example, co-trimoxazole.
- Metronidazole and tinidazole.
- Quinolones - for example, ciprofloxacin
- Nitrofurantoin - used for urinary infections.

As well as the above main types of antibiotics, there are a number of other antibiotics that specialist doctors

Side Effects of Antibiotics

Antibiotics are screened for any negative effects before their approval for clinical use, and are usually considered safe and well tolerated. However, some antibiotics have been associated with a wide extent of adverse side effects ranging from mild to very severe depending on the type of antibiotic used, the microbes targeted, and the individual patient. Side effects may reflect the pharmacological or toxicological properties of the antibiotic or may involve hypersensitivity or allergic reactions. Adverse effects range from fever and nausea to major allergic reactions, including photodermatitis and anaphylaxis.

Healthcare practitioners prescribe antibiotics to prevent and treat bacterial infections. Most antibiotics side effects are not life threatening. However, antibiotics may cause severe side effects in some people that require medical attention.

Antibiotics are generally safe, and doctors prescribe them to stop the growth of bacteria; for example, to treat bacterial infections, such as strep throat, urinary tract infections (UTIs), and certain skin infections.

Antibiotics do not work against viruses that cause most upper respiratory infections, the common cold, or COVID-19.

However, antibiotics can cause side effects, ranging from minor to severe to life threatening. According to the Centers for Disease Control and Prevention (CDC), 1 in 5Trusted Source medication-related emergency room visits are due to antibiotic side effects.

Antiseptics and Disinfectants

- **Antiseptic**

Antiseptics can be defined as antimicrobial agents which can be applied on the body of living organisms to inhibit the action of microbes. They are not injected into the body like the antibiotics, rather they are applied on the surface of the skin to heal the living tissues in case of wounds and cuts.

- **Disinfectant**

A disinfectant can be defined as an antimicrobial agent that can be applied on the surface of some objects in order to destroy the microorganisms residing on it.

Antiseptics and disinfectants are both widely used to control infections. They kill microorganisms such as bacteria, viruses, and fungi using chemicals called biocides. Disinfectants are used to kill germs on nonliving surfaces. Antiseptics kill microorganisms on your skin.

Types of Antiseptics

Some antiseptics are germicidal in nature, implying that they have the ability to completely destroy microbes. These types of antiseptics are referred to as bacteriocidal antiseptics. Other antiseptics only inhibit the growth of microbes (or prevent the growth of microbes altogether). Such substances are commonly referred to as bacteriostatic antiseptics.

Types of Disinfectants

Air disinfectants: It is defined as the chemical substances which are used to kill the microorganisms that are suspended in the air. It can also be called as a disinfectant spray.

Alcohol: It is seen that alcohols are used as disinfectants. Ethanol is the most common example in this case. Some other examples of disinfectants are, chlorine when it is in the concentration of 0.2 to 0.4 in aqueous solution and sulphur dioxide, which acts as a disinfectant in small concentrations.

There are many different types of disinfectants for use on surfaces. They are usually made for a specific purpose and are meant to be used a certain way because they don't work equally well against all microbes. Most disinfectants don't kill bacterial spores, for instance.

Disinfectants can contain the same types of chemicals as antiseptics but in higher concentrations. Disinfectants should not be used on your skin. Chemical disinfectants include:

- Alcohol
- Formaldehyde
- Chlorine and chlorine compounds
- Iodophors
- Ortho-phthalaldehyde (OPA)
- Phenolics
- Hydrogen peroxide
- Peracetic acid

Disinfectants have to be used properly to be effective. The manufacturer will include instructions for proper use.

Some factors that need to be considered are:

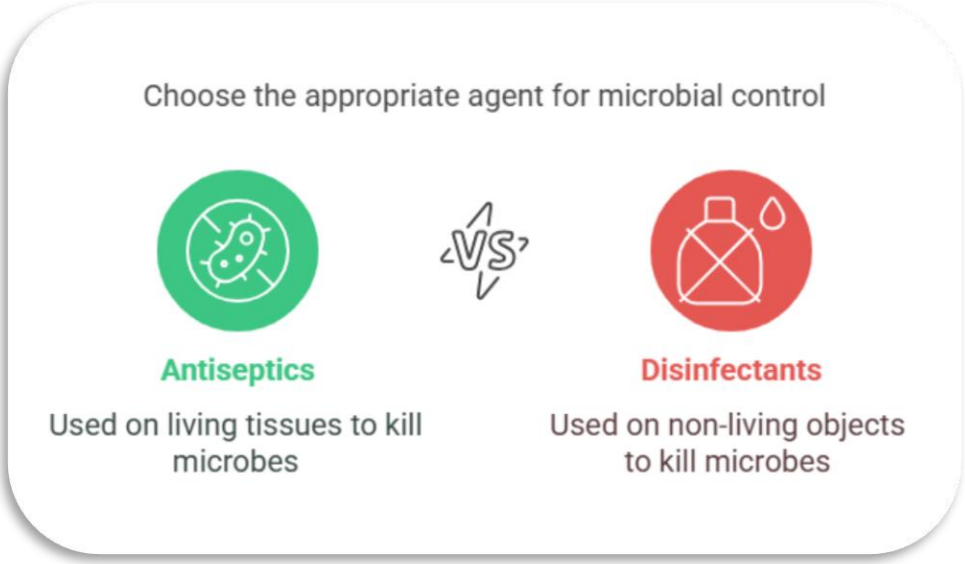
- If the disinfectant works against the microbe you're targeting
- If the disinfectant is at the right concentration
- How long the disinfectant needs to remain on the surface
- The disinfectant's expiration date
- Cleaning the area before you disinfect
- Proper pH level and water temperature
- Water hardness
- If the disinfectant is safe to use on the surface you're disinfecting

The Difference between Disinfectants and Antiseptics

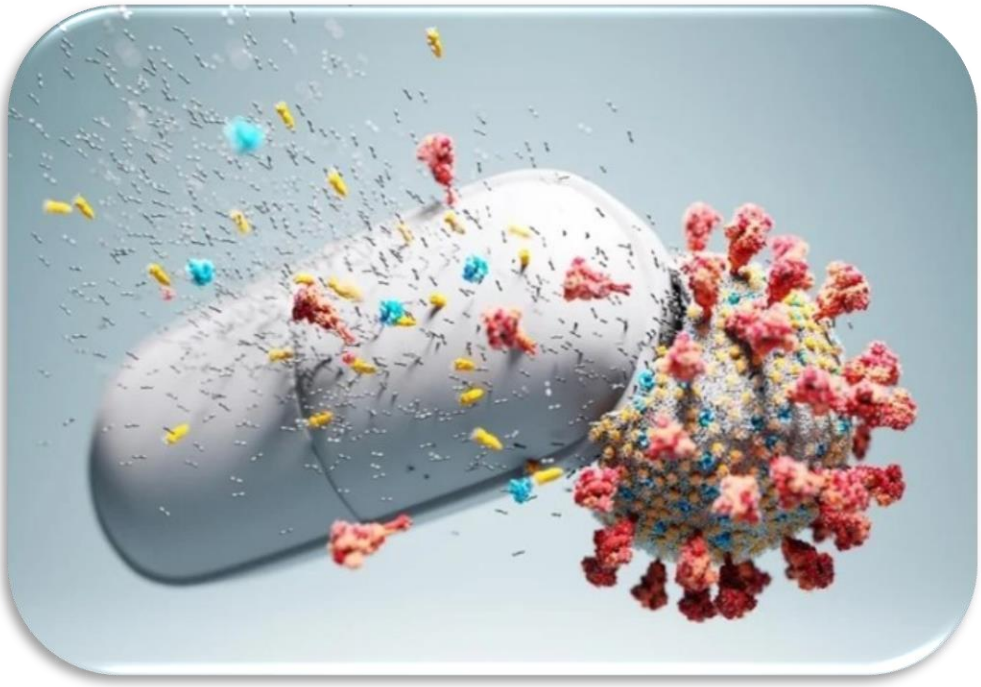
Disinfectants and antiseptics are both used for killing the microbes but still, there is a difference between them.

An antiseptic is used for killing the microbes on the living tissues whereas a disinfectant is applied on a non-living object.

Secondly, the concentration of both differ. We can use the same chemical as a disinfectant and an antiseptic by varying its concentration.



Antiviral drug



Antiviral drugs are a class of medication used for treating viral infections. Most antivirals target specific viruses, while a broad-spectrum antiviral is effective against a wide range of viruses. Antiviral drugs are a class of antimicrobials, a larger group which also includes antibiotic (also termed antibacterial), antifungal and antiparasitic drugs, or antiviral drugs based on monoclonal antibodies. Most antivirals are considered relatively harmless to the host, and therefore can be used to treat infections. They should be distinguished from virucides, which are not medication but deactivate or destroy virus particles, either inside or outside the body. Natural virucides are produced by some plants.

Medical uses

Most of the antiviral drugs now available are designed to help deal with HIV, herpes viruses, the hepatitis B and C viruses, and influenza A and B viruses.

Viruses use the host's cells to replicate and this makes it difficult to find targets for the drug that would interfere with the virus without also harming the host organism's cells. Moreover, the major difficulty in developing vaccines and antiviral drugs is due to viral variation.

The emergence of antivirals is the product of a greatly expanded knowledge of the genetic and molecular function of organisms, allowing biomedical researchers to understand the structure and function of viruses, major advances in the techniques for finding new drugs, and the pressure

placed on the medical profession to deal with the human immunodeficiency virus (HIV), the cause of acquired immunodeficiency syndrome (AIDS).

The first experimental antivirals were developed in the 1960s, mostly to deal with herpes viruses, and were found using traditional trial-and-error drug discovery methods

This was a very time-consuming, hit-or-miss procedure, and in the absence of a good knowledge of how the target virus worked, it was not efficient in discovering effective antivirals which had few side effects. Only in the 1980s, when the full genetic sequences of viruses began to be unraveled, did researchers begin to learn how viruses worked in detail, and exactly what chemicals were needed to thwart their reproductive cycle.

Antifungal

An antifungal medication, also known as an antimycotic medication, is a pharmaceutical fungicide or fungistatic used to treat and prevent mycosis, Such drugs are usually obtained by a doctor's prescription, but a few are available over the counter (OTC).

Side effects

Incidents of liver injury or failure among modern antifungal medicines are very low to non-existent. However, some can cause allergic reactions in people.

There are also many drug interactions. Patients must read in detail the enclosed data sheet(s) of any medicine. For example, the azole antifungals can be both substrates and inhibitors of the P-glycoprotein, which (among other functions) excretes toxins and drugs into the intestines.

Before oral antifungal therapies are used to treat nail disease, a confirmation of the fungal infection should be made. Approximately half of suspected cases of fungal infection in nails have a non-fungal cause. The side effects of oral treatment are significant and people without an infection should not take these drugs.

Antifungal Agents:

Fungal infections range from superficial (e.g., dermatophytosis) to systemic (e.g., candidiasis), requiring specific antifungal agents.

Mechanisms of Action:

1. **Cell Membrane Disruptors**
2. **Ergosterol Biosynthesis Inhibitors**
3. **Cell Wall Synthesis Inhibitors**
4. **Nucleic Acid Synthesis Inhibitors**

Antiparasitic Agents:

Parasitic infections, including malaria, leishmaniasis, and helminthiasis, require diverse therapeutic approaches.

Examples:

- **Antimalarials**
- **Anti-protozoals**
- **Anti-helminthics**

Challenges in Treatment:

- Drug resistance
- Complex life cycles requiring combination therapies
- Toxicity and limited drug availability in endemic areas