Pharmacology Chapter - 1

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- Bioavailability and the factors affecting bioavailability
- Drug distribution - definition, factors affecting drug distribution
- Biotransformation of drugs - Definition, types of biotransformation reactions, factors influencing drug metabolisms
- Excretion of drugs - Definition, routes of drug excretion

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Introduction Definition And Scope Of Pharmacology

- "Pharmacology" can be defined as the study of interactions between drug and biological system. It can be defined as the science of drugs or study of drug. The word "pharmacology " derived from Greek word.
- Pharmacon – Drug Logos – studied Which means pharmacology is the study of drug and their action of living body. It includes the knowledge of history source, biochemistry and physiological effects, mechanism of action and therapeutic uses of drug.

"Branch of pharmacology"

1. **Pharmacokinetics:–** What body does to the drug. In this the study of the action of drugs on target organ. It deals with the study of absorption, distribution, metabolism, excretion of drugs.
2. **Pharmacodynamics: –** What drugs dose the body. It deals with the mechanism of action and pharmacological effect of drug.

Scope of pharmacology Toxicology:-

- Toxicology is traditionally defined as "the science of poisons." It deals with effect of poisons methods for their detection, diagnosis and treatment.
- Chemotherapy:- It is the branch of pharmacology that deals with drugs, capable of destroying the causative organism without destroying host cells. The mechanism undertaken in chemotherapy.
- Pharmacopoeia :- It is an official code containing a list of selected established drugs and medical preparation with information about their physical property, taste for skin Identity purity and potency.

Ex- Indian pharmacopoeia, British pharmacopoeia, USP.

History of pharmacology:-

1. Francois Magendie (1783-1855):- A French physiologist loid down the dictres "Facts & Facts alone are the basis of science " Experimental procedures with animals are the testing grounds for determination of drug action.

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2. Claude Bernard (1813-1878):- Investigated the plant extract curare and proposal a site of action for this agent.

3. Rudolf Buchheim (1820- 1879):- In 1847 Buchheim established the first laboratory for experimental pharmacology in the basement of his home and named Cradle of experimental pharmacology.

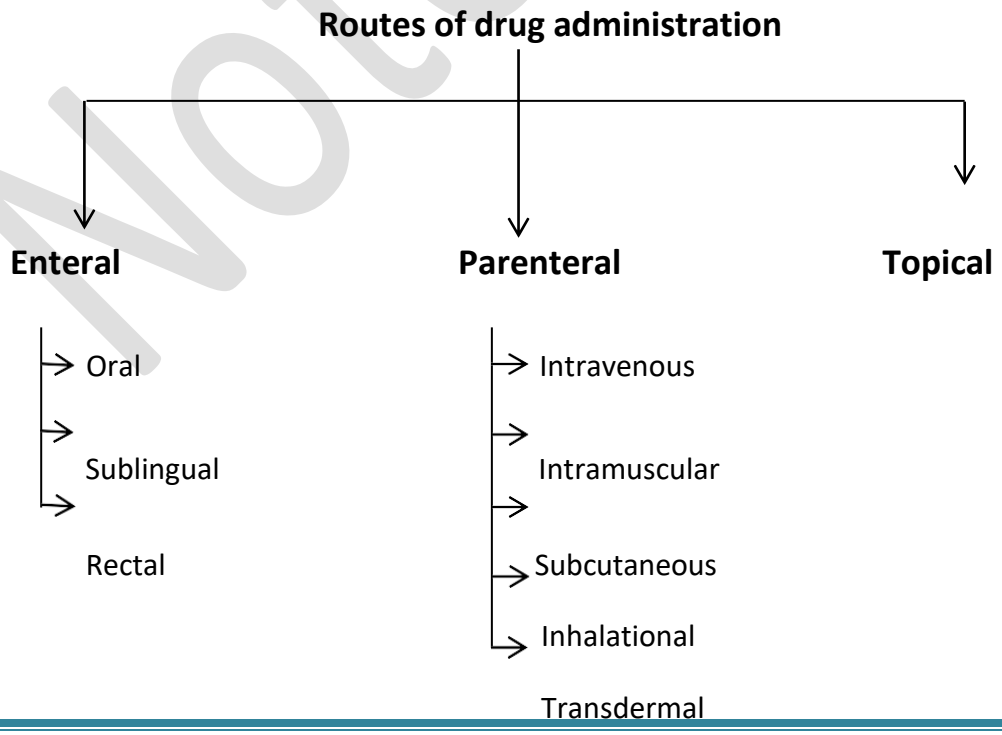
4. Oswald Schmiedeberg (1838-1921):- He is father of pharmacology and publish 1st journal of pharmacology. J.N. Longley (1852- 1925)- Herry dale (1875-1968):- Pioneered pharmacology in England taking physiological approach.

Various Routes of Drug Administration

Routes of administration

Introduction:- **Routes of drug administration** is the path by which the drug is introduced into the body for treatment of disease.

Drugs are available in various form like tablet, Capsule suspension, ointment, Cream, injection etc.



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1. External administration:- This route is best for drug administration unless any specific advantage is desired associated with other delivery route.

a) Oral :- In this route of administration the drug either liquid or solid preparation is placed in mouth cavity is swallowed along with drinks such as water, milk etc.

Advantage:-

- Most of medicinal preparations are consumed orally.
- Economical chance of acute drug reaction.
- Very convenient for children and aged people.

Disadvantage:-

- Sometime inefficient for the patients.
- Irritation to gastric mucosa.
- Can cause Nausea& vomiting.

b) Rectal: - Suppositories/ Enema are drug that are placed in rectal route.

Ex-Aspirin, Theophylline, Chlorpromazine.

Advantage:-

- Useful in the children/ adult.
- Use in the case of vomiting.
- Higher concentration of drug proparty achieved.

Disadvantage:-

- Irritation or inflammation of Rectal mucosa can occur.
- Absorption is slow of this route and Erratic.

Sublingual/ Buccal route

Sublingual:- This dosage form is placed under the tongue and allow to dissolve in the mouth cavity. The drug is absorbed by sublingual mucosa.

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Buccal route:- In buccal route drug kept within the mouth around the cheeks or buccal cavity, where it disintegrates and get absorbed.

Advantage:-

- Rapid absorption of the drug.
- Drugs do not undergo first- pass metabolism.
- Portal circulation is by passed.
- Maintained drug stability.
- No involvement of harsh GI environment.
- Less chance of infection.

Disadvantages:-

- Only small dose can take.
- Sometime complete drug is not absorbed.
- Not effective in emergencies.
- Drug couldn't be administered during emesis.
- Unpleasant teste of drugs.

2. Parenteral Administration:- The route of administration others than the enteral route comes under parenteral route. Parenteral Administration is injection or infusion by means of needle or catheter inserted in the body.

Intravenous (IV) Route

IV is the route of drug administration in which the drugs are administered into the veins. Injection are preferred for orally unabsorbed Drugs like Atracurium (neuromuscular blocker).IV route shows rapid effect the maintains level of drug in circulation.

Advantage:-

- 100% bioavailability.
- It this route shows rapid effect.
- This route is the best in the case of diarrhea and vomiting.

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- Take medicine in large quantities.

Disadvantage:-

- This route is less safe than oral route.
- Technical and trained person required.
- Costly.
- Inconvenient and painful causing irritation, cellulitis and thrombophlebitis.

. ***Intramuscular:-*** In this route the drug is administration into the muscles.

Advantage:-

- Rapid onset of action.
- No G.I.T. related factors.
- Mild irritants can be metabolism.
- The absorption is reasonably uniform.

Disadvantage:-

- Only 10ml of drug is given.
- Local pain cause, Abscess and infection.
- Can cause nervous damage.

Subcutaneous Route (SC)

This route of administration the drug gives under the skin.

Example:- Hormonal drug

(Insulin injection) Advantage:-

- Can be easily self-administering by the patient.
- Complete but slow adsorption.
- Low risk of systematic infection.

Disadvantage:-

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- Maximum 2ml of drug may be injected.
- Less painful then the IV /IM route.
- Irritatant drugs cause tissue damage.

Intara-arterial:-

This route of drug administration the drugs are given into the arteries. Vasodilator, anticancer drugs are given by skin route.

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Intara-arterial:-

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Advantage:-

- Bioavailability 100%.
- It is of great clinical value in administering anticancer drugs.

Disadvantage:-

- Only can used in cancer and vasodilator.
- Painful
- Risky

Inhalation :-

In case of inhalation route drugs are administered either as Aerosol system in the form of vapors

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Drug Absorption

Absorption is movement of the drug from its site of administration into the circulation. Not only the fraction of the administered dose that gets absorbed but also the rate of absorption is important.

Type of Absorption:

1. **Oral :-**

- The effective barrier to orally administered drugs is the epithelial lining of the G.I.T.
- The oral absorption of certain drugs is low because a fraction of the absorbed drug is extruded back into the intestinal lumen by the efflux transporter P-gp located in the gut epithelium.

Example:

1. Non-ionized lipid soluble drug-

- Ethanol are readily absorbed from stomach.

2. Water partition coefficient acidic drugs-

- Solicylates, barbiturates etc.

2. **Subcutaneous and intramuscular:-**

- In these routes the drug is deposited directly in the vicinity of the capillaries.
- Lipid soluble drugs pass readily across the whole surface of the the capillary endothelium.
- Adsorption from subcutaneous site is slower than that from intramuscular site both are generally faster and more consistent predictable than oral absorption.

3. **Topical sites (Skin, cornea, mucous membrane)**

- Drugs are typically applied to the skin when the skin is the desired site of action. In these cases systemic absorption where the drug penetrates beyond the layers of the epidermis to reach the bloodstream is generally not desirable and can cause systemic safety concerns.

Factors affecting drug Absorption:

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1. Routes of administration: This affects drug absorption because each routes has its own peculiarities.

2. Area of absorbing surface:
Large is the surface area, factor is the absorption

3. Aqueous Solubility: Drugs given in solid from must dissolve in the aqueous biophase before they are absorbed.

4. Concentration: Passive diffusion depends on concentration gradient drug given as concentrated solution is absorbed faster than from dilute solution.

5. Vascularity of the absorbing surface:

- Blood circulation removes the drug from the site of absorption and maintains the concentration gradient across the absorption surface.
- Increased blood flow hastens drug absorption as wind hostens drying of clothes.

Bioavailability

- The rate and extent of absorption of a drug from a dosage from administered by any route as determined by its concentration time curve in blood or by its excretion.

- Bioavailability of drug injection I.V is 100% but is frequently lower after oral injection because..

a) The drug may be incompletely absorbed.
b) The absorbed drug may undergo first pass metabolism in the intestinal wall/liver or be excreted in bile.

Factors affecting Bioavailability:

There are various factors which affects the bioavailability of drug.

A. Pharmaceutical factors:

- It is expected that bioavailability of drug to be in this decreasing order.
  Solutions>Suspension>Capsule> Tablet> Coated Tablet.

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- Partical Size
- Salt form
- Crystal Forms
- Natural excipients
- Partition coefficient

B. Pharmacological factors

- Stomach pH
- GI blood flow
- Enzyme
- Endogenous and bacterial
- Drug - Drug interactions
- First pass metabolism

C. Routes of administration

- Parenteral, Oral, Topical, Rectal, Inhalation

Parenteral>Oral>Rectal> Topical

Drug Distribution

- A drug has gained access to the blood stream it gets distributed to other tissues that initially has no drug concentration gradient being in the direction of plasma to tissues.
- The extent of distribution of a drug and it's pattern of tissue distribution depends on its
- Lipid solubility
- Ionization at physiological pH.
- Extent of binding to plasma and tissue proteins.
- Presence of tissue specific transporters
- Differences in regional blood flow.

- Movement of drug proceds until on equilibrium between unbound drug in the plasma and the tissue fluids. Subsequently there is a parallel decline in both due to elimination.

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$$V = \frac{\text{Dose administered I.V.}}{\text{Plasma Concentration}}$$

Where -
V= Apparent volume of distribution.

- Presuming that the body behaves as a single homogeneous compartment with volume V into which the drug gets immediately and uniformly distributed.

Factors affecting drug Distribution:

1. Tissue Permeability of Drugs

a) Physicochemical Properties of drug like:

- Molecular size, pKa, o/w Partition Coefficient

b) Physiological barriers to diffusion of drugs

2. Organ/tissue size and perfusion rate

3. Binding of drugs to tissue components. a) Binding of drug to blood components b) binding of drug to extra cellular components

4. Miscellaneous

- **Age**
- **Pregnancy**
- **Obesity**
- **Diet**
- **Disease states**
- **Drug interactions**

Metabolism/Biotransformation of drugs:-

- Metabolism/Biotransformation means chemical atteration of the drug in the body.

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- It is needed to render non polar (liquid soluble) compound polar (liquid insoluble) so that they are not reabsorbed in the renal tubulars and are excreted.
- The absence of metabolism body will not be able to get rid of lipophilic substances and they will become very long acting.
- The primary site for drug metabolism is liver.

Other are - Kidney, Intestine, lungs, and plasma.

Type of Metabolism/Biotransformation :

1. Inactivation:- Most drugs and their active metabolites are rendered inactive or less active.
Eg. Ibuprofen, paracetamol, lidocaine etc.

2. Active metabolite from an active drugs :

- Many drugs have been found to be properly converted to one or more active metabolite.
- The effects observed are the sumtotal of that due to the parent drug and it's active metabolite.

3. Activation of inactive drugs:

- Few drugs are inactive as such and need conversion in the body to one or more active metabolites such a drug is called a prodrug.
- The prodrug may offer advantages over the active form in being more stable having better bioavailability.

Biotransformation reaction can classified into:

A. Nonsynthetic /Phase I /Functionalization reactions :

- A functional groups (-OH,-COOH,-CHO,-NH2,-SH) is generated or exposed - metabolite may be active on inactive.

B. Synthetic/Conjunction/Phase II reactions:

- An endogenous radical is conjugated to the drug - metabolite is mostly inactive. Except few drugs.

e.g. glucuronide conjugate of morphine and sulfate conjugate of minoxidil are active.

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FACTORS AFFECTING DRUG METABOLISM:-

1. Age differences

2-Species and strain differences

3- Sex differences

4- Enzyme induction

5- Enzyme inhibition

6-Stereochemical Aspects of Drug metabolism

Excretion

- Excretion is the passage out of systemically absorbed drug. Drugs and their metabolites are excreted in:

Routes of Excretion:

1. **Urine:** Drug excretion in urine occurs via the kidney. It is the most important channel of excretion for majority of drugs.
2. Faeces:
   - Apart from the unabsorbed fraction, most of the drug present in faeces is derived from bile.
   - Liver actively transports into bile organic acids (especially drug glucuronides by OATP and MRP2), organic bases (by OCT), other lipophilic drugs (by P-gp) and steroids by distinct nonspecific active transport mechanisms.
   - Relatively larger molecules (MW > 300) are preferentially eliminated in the bile.
   - Most of the free drug in the gut, including that released by deconjugation of glucuronides by enteric bacteria is reabsorbed (enterohepatic cycling) and ultimate excretion occurs in urine.
   - Only the remaining is excreted in the faeces. Enterohepatic cycling contributes to longer stay of the drug in the body.
   - Drugs that attain high concentrations in bile include erythromycin,

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ampicillin, rifampin, tetracycline, oral contraceptives, vecuronium, phenolphthalein.Certain drugs are excreted directly in colon,
e.g. anthracene purgatives, heavy metals.

3. **Exhaled air:**

- Gases and volatile liquids (general anaesthetics, alcohol) are eliminated by lungs, irrespective of their lipid solubility.
- Alveolar transfer of the gas/vapour depends on its partial pressure in the blood.
- Lungs also serve to trap and extrude any particulate matter that enters circulation.

4. **Saliva and sweat:**

- These are of minor importance for drug excretion. Lithium, pot. iodide, rifampin and heavy metals are pres ent in these secretions in significant amounts.
- Most of the saliva along with the drug in it, is swallowed and meets the same fate as orally taken drug.

5. Milk:

- The excretion of drug in milk is not important for the mother, but the suckling infant inadvertently receives the drug. Most drugs enter breast milk by passive diffusion. As such, more lipid soluble and less protein bound drugs cross better.
- Milk has a lower pH (7.0)

General mechanisms of drug action and factors modifying drug action

General mechanisms of drug action:

- Pharmacodynamics is the study of drug ef fects.
- It starts with describing what the drugs do, and goes on to explain how they do it. Thus, it attempts to elucidate the complete action-effect sequence and the dose-effect relationship.

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- Modification of the action of one drug by another drug is also an aspect of pharmacodynamics.

1. Body size
2. Age – pediatric & geriatric
3. Sex
4. Species and race
5. Genetics –P'genomics and P'genetics
6. Routes of drug administration
7. Pregnancy & Lactation
8. Physiological states– GI diseases,congestive heart disease, thyroid disease, kidney & liver disease
9. Diet &Environmental factors
10. Psychological factors
11. Cumulation
12. Tolerance & resistance

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Chapter -2 | Unit-1

Drugs Acting on the Peripheral Nervous System

Steps involved in neurohumoral transmission Definition, classification, pharmacological actions, dose, indications, and contraindications of

a) Cholinergic drugs
b) Anti-Cholinergic drugs

Drugs Acting on the Peripheral Nervous System

- The peripheral nervous system consists of the nerves that branch out from the brain and spinal cord. These nerves form the communication network between the CNS and the body parts. The peripheral nervous system is further subdivided into the somatic nervous system and the autonomic nervous system. The somatic nervous system consists of nerves that go to the skin and muscles and is involved in conscious activities. The autonomic nervous system consists of nerves that connect the CNS to the visceral organs such as the heart, stomach, and intestines.

- NEURO-HUMORAL TRANSMISSION Neurohumoral transmission implies that nerves transmit their message across synapses and neuro-effector junctions by the release of humoral chemical) messengers.

Steps in neurohumoral transmission:

1. lmpulse conduction :

- The resting transmembrane potential (-70 mV) is established by high K* permeability of axonal membrane and high axoplasmic concentration of this ion coupled with low Na* permeabilitv and its active extrusion from the neuron stimulation or arrival of an electrical impulse causes a sudden increase in Na* conductance depolarization and overshoot (reverse polarization, inside becoming 20 mV positive); K* ions then move out in the direction of their concentration gradient &

repolarisation occurs. Ionic distribution is normalized during the refractory period by the activation of Na* K* pump.

- The action potential (AP) thus generated sets up local circuit currents which activate ionic channels at the next excitable part of the membrane (next node of Ranvier in myelinated nerve) and the AP is propagated without decrement.

2.Transmitter release:

- The transmitter (excitory or inhibitory) is stored in prejunctional nerve endings within sympathetic vesicles. Nerve impulse promotes fusion of vesicular and neuronal membranes through Ca+2 entry which fluidizes membranes.
- All contents of the vesicle transmitter, enzymes and other proteins) are extruded (exocytosis) in the junctional cleft. The release process can be modulated by the transmitter itself and by other agents through activation of specific receptors located on the prejunctional membrane.

Example : Noradrenaline (NA) release is inhibited by NA (receptor), dopamine, adenosine, prostaglandins and enkephalins while isoprenaline (B2 receptor) and angiotensin AT1 receptor) increase NA release.

3.Transmitter action on postiunctional membrane:

- The released transmitter combines with specific receptors on the postjunctional membrane and depending on its nature induces an excitatory postsynaptic potential (EPSP) or an inhibitory postsynaptic potential (IPSP).

a) **EPSP:** Increase in permeability to all cations -> Na* or Ca2* influx (through fast or slow channels) causes depolarization followed by K* efflux. These ionic movements are passive as the flow is down the concentration gradients.

b) **IPSP:** Increase in permeability to smaller ions, i.e. K* and Cl- (hydrated K+ ion is smaller than hydrated Na* ion) only, so that K* moves out and Cl- moves in (in the direction of their concentration gradients) resulting in hyperpolarisation.

4. Postjunctional activity:

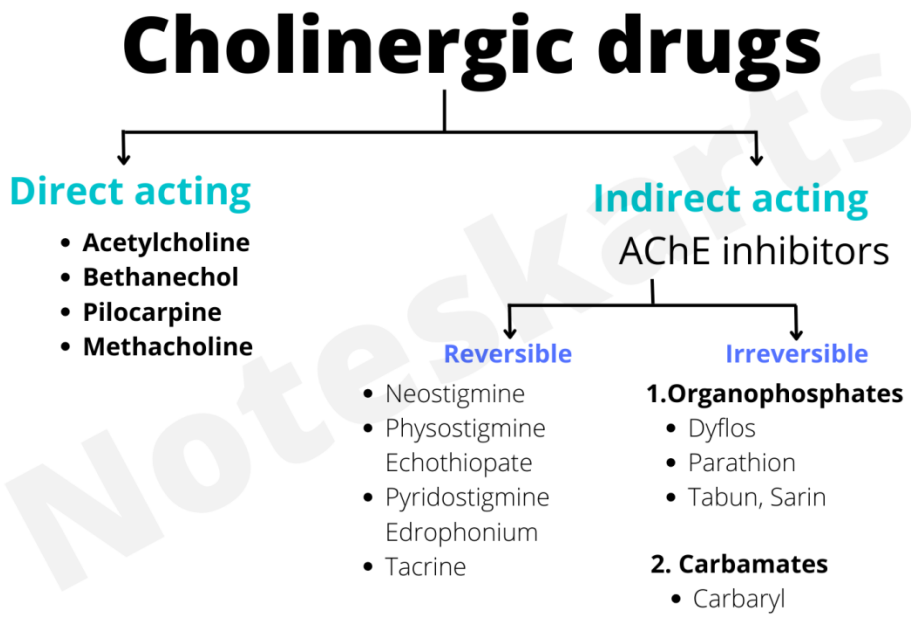
- A suprathreshold EPSP generates a propagated postjunctional AP which results in nerve impulse (in neurone), contraction (in muscle) or secretion (in gland). An IPSP stabilizes the postjunctional membrane and resists depolarizing stimuli.

5. Termination of transmitter action : Following its combination with the receptor, the transmitter is either locally degraded (e.g. ACh) or is taken back into the prejunctional neurone by active uptake or diffuses away (e.g. NA,GABA).

a) Cholinergic drugs:

- These are the drugs which produces actions similar to that of ACh, either by directly or indirectly interacting with cholinergic receptors or by increasing availability of Ach at these sites (anticholinesterases).

Classification of Cholinergic drugs



Pharmacological actions of Cholinergic drugs:

A. Muscarinic actions:

a. Heart.

- ACh hyperpolarizes the SA nodal cells and decreases their rate of diastolic depolarization. As a result, rate of impulse generation is reduced-bradycardia or even cardiac arrest may occur.
- At the A-V node and His-Purkinje fibres refractory period (RP) is increased and conduc tion is slowed: P-R interval increases and partial to complete A-V block may be produced.
- The force of atrial contraction is markedly reduced and RP of atrial fibres is abbreviated. Due to nonuniform vagal innervation, the intensity of effect on RP and conduction of different atrial fibres varies-inducing inhomogeneity and pre disposing to atrial fibrillation or flutter.
- Ventricular contractility is also decreased but the effect is not marked. The cardiac muscarinic receptors are of the M, subtype.

b. Smooth muscle

- Smooth muscle in most organs is contracted (mainly through M, recep tors). Tone and peristalsis in the gastrointestinal tract is increased and sphincters relax →abdominal cramps and evacuation of bowel.
- Peristalsis in ureter is increased.
- The detrusor muscle contracts while the bladder trigone and sphincter relaxes → voiding of bladder.

- Bronchial muscles constrict, asthmatics are highly sensitive → bronchospasm, dyspnoea, precipitation of an attack of bronchial asthma.

c. Glands

- Secretion from all parasympathe tically innervated glands is increased via M and some M, receptors: sweating, salivation, lacrimation, increased tracheobronchial and gastric secretion.
- The effect on pancreatic and intestinal glands is not marked. Secretion of milk and bile is not affected.

d. Eye

- Contraction of circular muscle of iris resulting in miosis.

- Contraction of ciliary muscle causing spasm of accommodation, increased aqueous outflow facility, reduction in intraocular tension (especially in glaucomatous patients).

B. Nicotinic actions

1. Autonomic ganglia Both sympathetic and parasympathetic ganglia are stimulated. This effect is manifested at higher doses. High dose of ACh given after atropine causes tachycardia and rise in BP due to stimulation of sympathetic ganglia and release of catecholamines.

2. Skeletal muscles Iontophoretic application of ACh to muscle endplate causes contraction of the fibre. Intraarterial injection of high dose can cause twitching and fasciculations, but i.v. injection is generally without any effect (due to rapid hydrolysis of ACh).

3. CNS actions

ACh injected i.v. does not penetrate blood-brain barrier and no central effects are seen. However, direct injection into the brain produces arousal response followed by depression. Cholinergic drugs which enter brain produce complex behavioral and neurological effects.

Indications

- Indirect-acting cholinergic agonists are indicated for the following medical conditions:
- Treatment of myasthenia gravis, antidote for nondepolarizing neuromuscular junction blockers, increased survival after exposure to nerve gas
- Treatment of mild to moderate Alzheimer's disease.

- Contraindications and Cautions

The following are contraindications and cautions for the use of indirect-acting cholinergic agonists:

- Allergy
- Bradycardia, intestinal/urinary tract obstruction.
- Pregnancy
- Asthma, coronary disease, peptic ulcer, arrhythmias, epilepsy, parkinsonism.
- Hepatic or renal dysfunction

Anti-Cholinergic drugs:

- The Anti-Cholinergic drugs is restricted to those which block actions of ACh on automatic effectors and in the CNS exerted through muscarinic receptors.

Classification of Anti-Cholinergic drugs

1. Natural alkaloids:- Atropine, Hyoscine (Scopolamine).

2. Semisynthetic derivatives:- Homatropine, Atropine methonitrate, Hyoscine butyl bromide, Ipratropium bromide, Tiotropium bromide.

3. Synthetic compounds

(a) **Mydriatics:** Cyclopentolate, Tropicamide.
(b) Antisecretory - antispasmodics:
- **(i) Quaternary compounds:** Propantheline, Oxyphenonium, Clidinium, Pipenzolate methyl bromide, Isopropamide, Glycopyrrolate.
- **(ii) Tertiary amines:** Dicyclomine, Valethamate, Pirenzepine

(c) **Vasicoselective:** Oxybutynin, Flavoxate, Tolterodine.
(d) **Antiparkinsonian:** Trihexyphenidyl (Benzhexol), Procyclidine, Biperiden.

Atropine

Atropine is a prescription medicine used to treat the symptoms of low heart rate (bradycardia), reduce salivation and bronchial secretions before surgery or as an antidote for overdose of cholinergic drugs.

Pharmacological actions of atropine :

1. CNS

- Atropine has an overall CNS stimulant action. However, these effects are not appreciable at low doses which produce only peripheral effects because of restricted entry into the brain. Hyoscine produces central effects (depressant) even at low doses.
- Atropine stimulates many medullary centres -vagal, respiratory, vasomotor.
- It depresses vestibular excitation and has antimotion sickness property.
- The site of this action is not clear-probably there is a cholinergic link in the vestibular pathway, or it may be exerted at the cortical level.
- By blocking the relative cholinergic over activity in basal ganglia, it suppresses tremor and rigidity of parkinsonism.
- High doses cause cortical excitation, restless ness, disorientation, hallucinations and delirium followed by respiratory depression and coma.
- Majority of the central actions are due to blockade of muscarinic receptors in the brain, but some actions may have a different basis.

2. Eye:

- The autonomic control of iris muscles and the action of mydriatics as well as miotics is illustrated.

- Topical instillation of atropine causes mydriasis, abolition of light reflex and cycloplegia lasting 7-10 days. This results in photophobia and blurring of near vision. The ciliary muscles recover somewhat earlier than sphincter pupillae.
- The intraocular tension tends to rise, especially in narrow angle glaucoma. However, conventional systemic doses of atropine produce minor ocular effects.

3. CVS : -

- Most prominent effect is to cause tachycardia due to blockade of M2 receptors at SA node.

Indications

Atropine is indicated for the treatment of poisoning by susceptible organophosphorus nerve agents having anticholinesterase activity as well as organophosphorus or carbamate insecticides in adults and pediatric patients weighing more than 41 kg

Contraindications

- Fast heartrate
- High pressure in the eye (glaucoma)
- Abdominal blockage (pyloric obstruction)
- Dry mouth
- Blurred vision
- Sensitivity to light
- Lack of sweating
- Dizziness
- Nausea

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Chapter -2 | Unit-2
Adrenergic Drugs (Sympathomimetics)

These are drugs with actions similar to that of Adr or of sympathetic stimulation.

Classification Of Adrenergic Drugs

1. **Direct sympathomimetics:** They act directly as agonists on α and/or β adrenoceptors— Adr, NA, isoprenaline (Iso), phenylephrine, methoxamine, xylometazoline, salbutamol and many others.
2. **Indirect sympathomimetics:** They act on adrenergic neurone to release NA, which then acts on the adrenoceptors—tyramine, amphetamine.
3. **Mixed action sympathomimetics:** They act directly as well as indirectly—ephedrine, dopamine, mephentermine.

Pharmacological Action:

α actions	*β actions*
1. Constriction of arterioles and veins → rise inBP (α_1 + α_2)	Dilatation of arterioles and veins → fall in BP (β_2)
2. Heart—little action, arrhythmia at high dose (α_1)	Cardiac stimulation (β_1), ↑ rate, force and conduction velocity
3. —	Bronchodilatation (β_2)
4. Contraction of radial muscles of iris → mydriasis (α_1), decreased aqueous secretion	No effect on iris, slight relaxation of ciliary muscle, Enhanced aqueous secretion
5. Intestinal relaxation, contraction of sphincters	Intestinal relaxation (β_2)
6. Bladder trigone—contraction (α_1)	Detrusor—relaxation (β_2)
7. Uterus—contraction (α_1)	Relaxation (β_2)
8. Splenic capsule—contraction (α_1)	Relaxation (β_2) (slight)
9. Neuromuscular transmission facilitated, ↑ ACh release	Active state—prolonged in fast contracting muscle, abbreviated in slow contracting muscle; tremors (β_2)
10. Insulin secretion inhibited (α_2) (dominant)	Augmented insulin (mild) and glucagon secretion (β_2)
11. Liver—glycogenolysis (α in some species)	Liver—glycogenolysis (β_2) → hyperglycaemia Muscle—glycogenolysis (β_2) → hyperlactacidaemia Fat—lipolysis (β_1 + β_2 + β_3) → increased blood FFA, calorigenesis
12. —	Renin release from kidney (β_1)
13. Male sex organs—ejaculation (α_1)	—
14. Salivary gland—K^+ and water secretion (α_1)	Ptylin secretion
15. —	ADH secretion from posterior pituitary (β_1)
16. Nictitating membrane—contraction (in animals)	—

Salbutamol

Salbutamol is a beta-2 adrenergic receptor agonist used to treat asthma, bronchitis, COPD, as well as prevent exercise induced bronchospasms.

Mechanism of action:

- Salbutamol stimulate β2 adrenergic receptors which are predominant receptors in bronchial smooth muscle (β2-receptors are present in human heart in a concentration between 10% and 50%).
- Stimulation of β2 receptors leads to the activation of enzyme adenyl cyclase that form cyclic AMP (adenosine-mono-phosphate) from ATP (adenosine-tri-phosphate).

Dose

- The usual dose of oral salbutamol is 2 to 4 mg three times a day in adult and 1 to 2 mg three times a day in children.

Adverse effect / Indication:

- The most common adverse reactions associated with use of salbutamol inhalation aerosol are palpitations (occurring in less than 10% of patients, anxiety (less than 10%), tremors (less than 15% of patients) and increased blood pressure (approximately 5%), occasionally resulting in hypertension.
- The most common adverse reactions to salbutamol tablets or syrup are tremors (occurring in 10-20% of patients) and anxiety (9- 20%).

Contraindication:

- Salbutamol and Pregnancy
- Caution when used during pregnancy.
- Either studies in animals have revealed adverse effects on the foetus (teratogenic or embryocidal or other) and there are no controlled studies in women or studies in women and animals are not available.
- Drugs should be given only if the potential benefit justifies the potential risk to the foetus.

Antiadrenergic Drugs

These are drugs which antagonize the receptor action of adrenaline and related drugs. They are competitive antagonists at α or β or both α and β adrenergic receptors and differ in important ways from the “adrenergic neurone blocking agents”, which act by interfering with the release of adrenergic transmitter on nerve stimulation.

Noteskarts

Classification of Antiadrenergic Drugs

I. Nonequilibrium type

(i) β-Haloalkylamines—Phenoxybenzamine.

II. Equilibrium type (competitive)

A. Nonselective
(i) Ergot alkaloids—Ergotamine, Ergotoxine
(ii) Hydrogenated ergot alkaloids—Dihydroergotamine (DHE), Dihydroergotoxine
(iii) Imidazoline—Phentolamine
(iv) Miscellaneous–Chlorpromazine

B. α1 selective—Prazosin, Terazosin, Doxazosin, Alfuzosin, Tamsulosin

C. α2 selective—Yohimbine

Phenoxybenzamine

- Phenoxybenzamine is used to treat episodes of high blood pressure and sweating related to pheochromocytoma.

Dose:

- 20–60 mg/day oral; 1 mg/kg by slow i.v. infusion over 1 hour; used primarily in pheochromocytoma, occasionally in secondary shock and peripheral vascular disease.
- FENOXENE 10 mg cap, 50 mg/ml inj. BIOPHENOX 50 mg in 1 ml inj.

Indication:

Phenoxybenzamine is indicated for the control of episodes of hypertension and sweating that occur with a disease called pheochromocytoma. If tachycardia is excessive, it may be necessary to use a beta-blocking agent concomitantly.

Contraindication:

- Nasal congestion
- Dizziness
- Upset stomach
- Sexual dysfunction (difficulty ejaculating)
- Dizziness

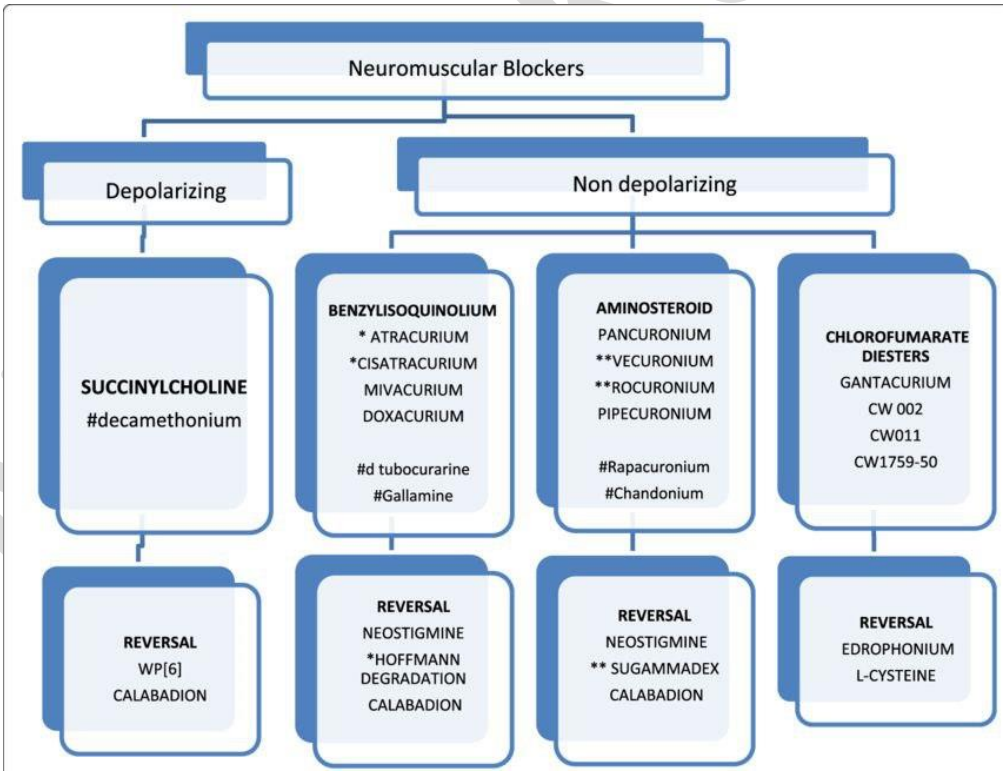
Noteskarts

Chapter-2 | Unit-3

Neuromuscular blocking agents:-

Neuromuscular blocking agents are potent muscle relaxants typically only used during surgery to prevent muscle movement. They are structurally related to acetylcholine (the main neurotransmitter in the body) and they cause muscle relaxation by binding to acetylcholine receptors postsynaptically (which prevents acetylcholine from binding). This blocks neuromuscular transmission and causes paralysis of the muscle.

Classification:



Dose:

Table 1. Pharmacokinetics of Neuromuscular Blockers

Agent	Dosing	Time to Peak (min)	Duration of Action (min)	Metabolism	Side Effects
			NONDEPOLARIZING		
Aminosteroids					
Pancuronium	0.05-0.1 mg/kg bolus; 0.8-1.7 mcg/kg/min infusion	2-3	60-100	Renal	Tachycardia, hypotension, and increased cardiac output
Vecuronium	0.08-0.1 mg/kg bolus; 0.8-1.7 mcg/kg/min infusion	3-4	20-45 (prolonged as active metabolite builds up)	Hepatic via hydrolysis, then bile; metabolites excreted renally	Hemodynamic instability
Rocuronium	0.6-1 mg/kg bolus; 8-12 mcg g/kg/min infusion; RSI: 1-1.2 mg/kg bolus	1-2	20-35 for bolus dose; 60-80 for RSI dose	Hepatic; no active metabolites	NA
Benzylisoquinoliniums					
Atracurium	0.4-0.5 mg/kg bolus; 5-20 mcg g/kg/min infusion	3-4	20-35	Hoffmann reaction	Seizures associated with neurotoxic metabolite (laudanosine), hypotension (histamine release)
Cisatracurium	0.1-0.2 mg/kg bolus; 3 mcg g/kg/min initial infusion; 1-2 mcg g/kg/min maintenance infusion	2-3	30-60	Hoffmann reaction	Bronchospasm
			DEPOLARIZING		
Succinylcholine	1 mg/kg bolus; infusions rarely used	<1	5-10	Plasma cholinesterase	Bradycardia, malignant hyperthermia, and hyperkalemia

min: minute; NA: not applicable; RSI: rapid sequence intubation.
Source: References 5-7, 12, 25, 31, 32.

Myasthenia Gravis

It is an autoimmune disorder affecting about 1 in 10,000 population, due to development of antibodies directed to the nicotinic receptors (NR) at the muscle endplate. The number of free Nm cholinoceptors may be reduced to 1/3 of normal or less and structural damage to the neuromuscular junction.

Drugs used in Myasthenia gravis

- Neostigmine
- Ambenonium
- Azathioprine
- Edrophonium Injection

Neostigmine:

Neostigmine is a cholinesterase inhibitor, prescribed for Myasthenia Gravis. It inhibits the chemicals, which brings non-communication between the nervous and the muscular system. Neostigmine enhances the muscular movements in case of Myasthenia Gravis condition.

Dose: 0.5-2.5mg I.M./S.C. 15-30 mg orally

Indications:

- Muscle relaxant - reversal of non depolarising Muscle relaxant.
- Myasthenia gravis

Contraindications:

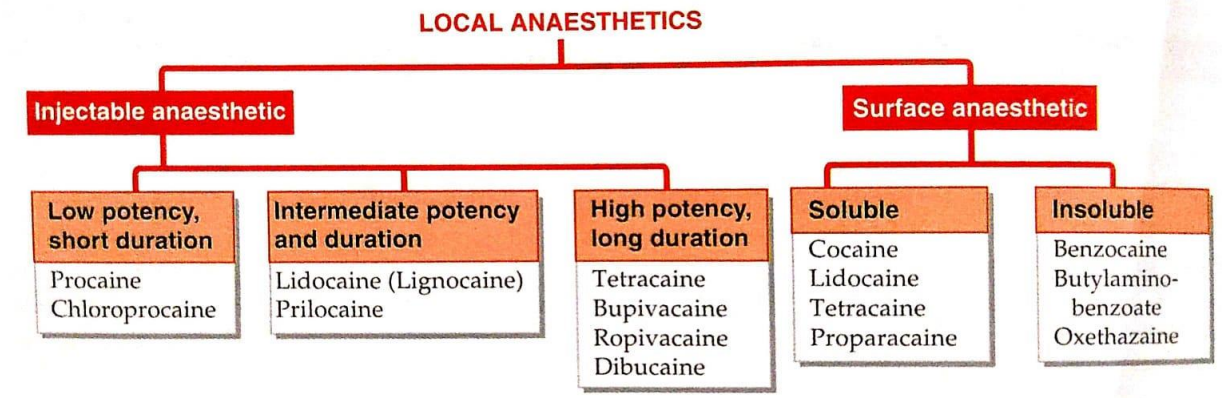
- Contraindications of neostigmine include hypersensitivity to neostigmine and peritonitis or mechanical obstruction of the intestinal or urinary tract.

Noteskarts

Local anesthetics

- Local anaesthetics (LAS) are drugs which upon topical application or local injection cause reversible loss of sensory perception, especially of pain, in a restricted area of the body.

Classification:



Some drugs use in local anaesthetics:

- Lidocaine
- Bupiva

Dose

Comparative features of commonly used local anaesthetics

Drug	Surface anaesthesia	Nerve block					Cardio-toxicity
		Relative potency	Conc. used (%)	Max. dose	Onset	Duration (Min)	
Lidocaine	+	1	0.5–2.0	300 mg	Fast	60–120	+
Bupivacaine	–	4–5	0.25–0.5	150 mg	Interm.	120–360	+++
Ropivacaine	–	3–4	0.25–0.75	200 mg	Slow	120–300	++

Indications:

- Local anesthesia is given to reduce the stress associated with surgery, and to provide pain relief after surgery.
- More commonly, it is used for pain caused by hemorrhoids, fissures, insect bites, and minor burns.
- It is applied topically for these conditions. It is also indicated for vaginal, rectal and otological examinations, cystoscopy, and catheterization.

Contraindications:

- Convulsions, tremors, dizziness, blurred vision, nervousness, nausea
- Cardiovascular collapse and cardiac arrest may also occur in some cases
- Paralysis of the injected area.

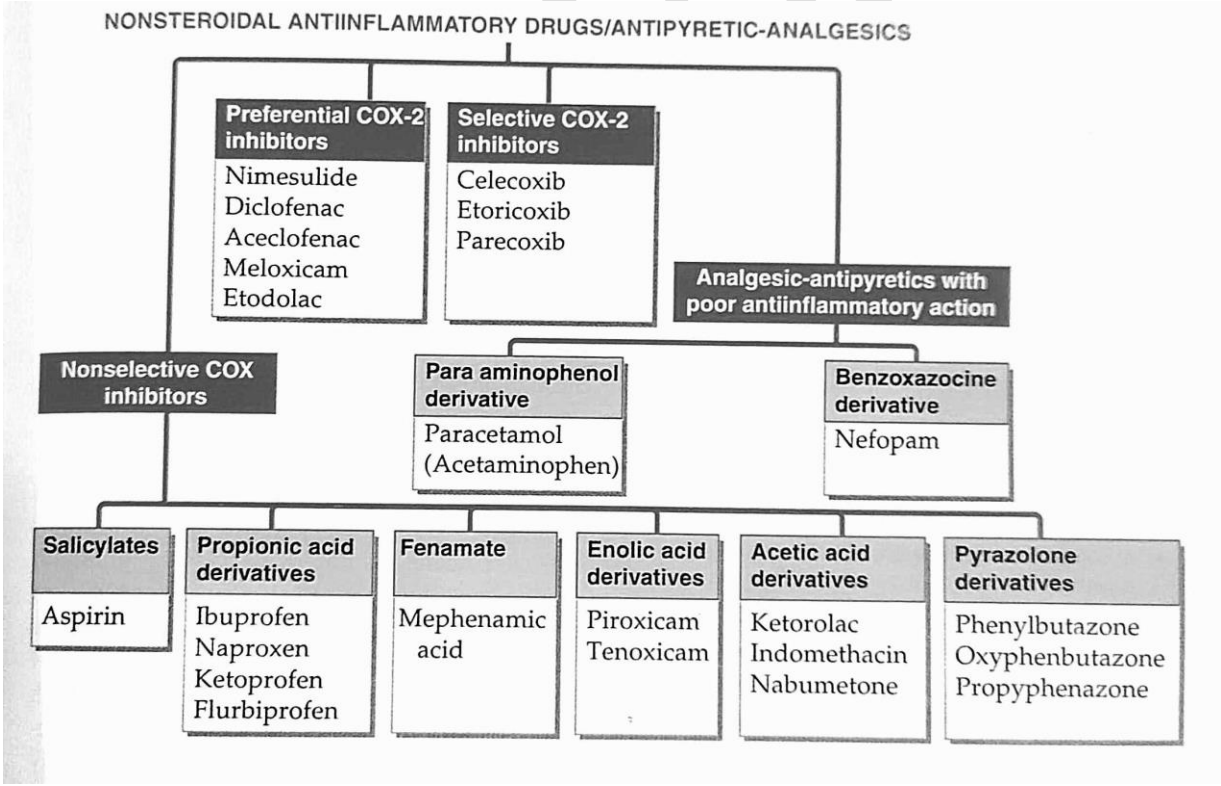
Noteskarts

Non-steroidal anti-inflammatory drugs (NSAIDs)

The nonsteroidal antiinflammatory drugs (NSAIDs) and antipyretic analgesics are a class of drugs that have analgesic, antipyretic and antiinflammatory actions in different measures. In contrast to morphine they do not depress CNS.

They are also called nonnar cotic, nonopioid or aspirin-like analgesics.

Classification:

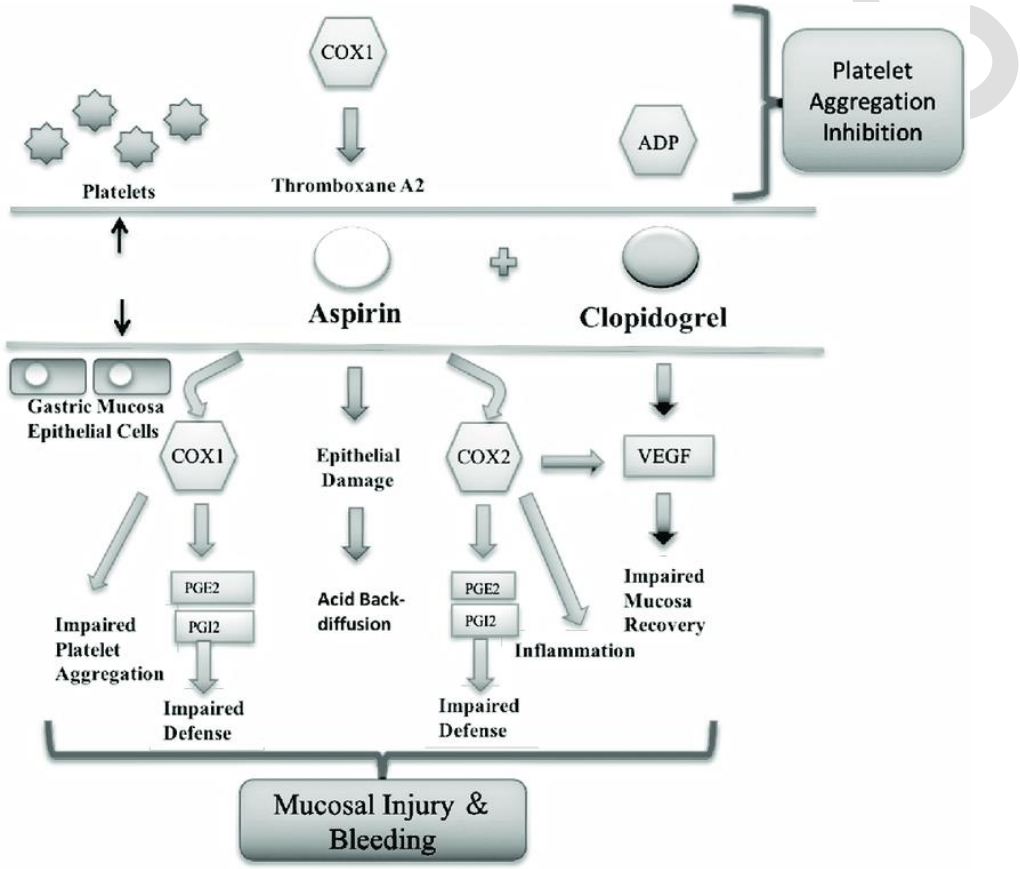


Aspirin

Aspirin is acetylsalicylic acid. It is rapidly converted in the body to salicylic acid which is responsible for most of the action.

It used to treat pain, fever, inflammation, migraines, and reducing the risk of major adverse cardiovascular events.

Pharmacological Action:



Indication :

Pain, fever, and inflammation cold, neck and back pain, dysmenorrhea, headache, tooth pain, sprains, fractures, myositis, neuralgia, synovitis, arthritis, bursitis, burns, and various injuries.

Contraindication:

- Sensitive Persons
- Children with viral diseases
- Peptic ulcer disease and bleeding disorders

- Chronic liver diseases
- Diabetes, CHF and juvenile Rh. Arthritis
- G-6-PD deficient persons
- Stop prior to surgery, near term pregnancy, breast feeding mothers etc.

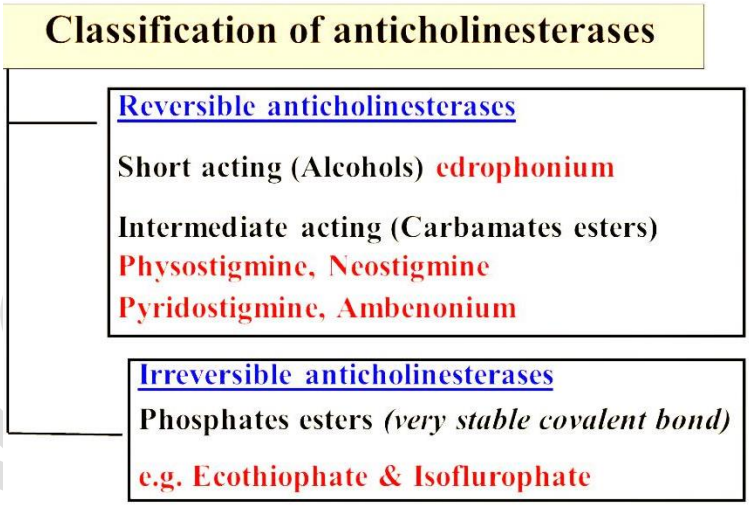
Noteskarts

Chapter-3 | Pharmacology

Drugs acting on the Eye:

Miotics:

- The 1970s topical pilocarpine alone or combined with antiChEs were the standard antiglaucoma drugs.
- Drugs that constrict the pupil.
- They may be used in the treatment of glaucoma and accommodative esotropia and, sometimes, after a mydriatic examination.
- Miotics are either parasympathomimetic (cholinergic-stimulating) drugs which have a direct muscarinic action, such as pilocarpine and carbachol, or anticholinesterase drugs which block the effect of acetylcholinesterase thus letting acetylcholine produce its effect, such as physostigmine and neostigmine etc.



Neostigmine:

- Neostigmine is a cholinesterase inhibitor used in the symptomatic treatment of myasthenia gravis by improving muscle tone.

Pharmacological Action

- Neostigmine is a parasympathomimetic, specifically, a reversible cholinesterase inhibitor.
- The drug inhibits acetylcholinesterase which is responsible for the degredation of acetylcholine. So, with acetylcholinesterase inhibited, more acetylcholine is present By interfering with the

breakdown of acetylcholine, neostigmine indirectly stimulates both nicotinic and muscarinic receptors which are involved in muscle contraction.

- It does not cross the blood-brain barrier.

Indications

- Miotics
- Myasthenia gravis
- Muscle relaxant- reversal of non-depolarising muscle relaxant

Contraindication:

- Contraindicated in patients with known hypersensitivity to the drug. Because of the presence of the bromide ion, it should not be used in patients with a previous history of reaction to bromides.
- It is contraindicated in patients with peritonitis or mechanical obstruction of the intestinal or urinary track.

Mydriatics

- Mydriatics are types of medicine that make the pupil of the eye dilate (open up).
- Mydriatics also tend to relax the focusing muscles of the eye, which means that blurred vision is a common side effect.

The commonly used mydriatics comprise two groups of drugs:

a) **Parasympatholytic,** which cause pupillary dilatation and paralysis of accommodation by rendering the sphincter pupillae and ciliary muscles insensitive to acetylcholine.
b) **Sympathomimetic,** which imitate or potentiate the action of adrenaline and produce pupillary dilatation but no cycloplegia.

- These drugs potentiate the action of parasympatholytic drugs. Most mydriatics reach their maximal effect by 30 to 6o minutes, although in children and people with deeply pigmented irides this may take longer.

Classification of Mydriatics:

1. **Anti-cholinergics**
   - Atropine
   - Cyclopentolate
   - Tropicamide

2. **Adrenergics**
   - Adrenaline
   - Ephedrine
   - Phenylephrine

3. **General anesthetics**
   - Ether
   - Halothane

4. **Local Anesthetics**
   - Cocaine

Atropine

- Atropine is a prescription medicine used to treat the symptoms of low heart rate (bradycardia), reduce salivation and bronchial secretions before surgery or as an antidote for overdose of cholinergic drugs or mushroom poisoning. Atropine may be used alone or with other medications.

Pharmacological Action of Atropine

- Atropine binds to and inhibits muscarinic acetylcholine receptors, competitively blocking the effects of acetylcholine and other choline esters.
- It acts as a reversible non-specific antagonist of muscarinic receptors, showing affinity for the M1, M2, M3, M4 and M5 receptor subtypes.
- Atropine antagonizes the effects of acetylcholine on tissues innervated by postganglionic cholinergic nerves, such as smooth muscle, cardiac tissue, exocrine glands and the central nervous system. Also, it acts in less innervated smooth muscle that responds to endogenous acetylcholine.
- The actions of atropine can be overcome by increasing the concentration of acetylcholine at receptor sites (for instance, the use of anticholinesterase agents that inhibit the hydrolysis of acetylcholine)

Dose

- **Intramuscular device**
  - 0.25mg/0.3mL
  - 0.5mg/0.7mL
  - 1mg/0.7mL
  - 2mg/0.7mL

Indications

- For causing mydriasis.
- Atropine is indicated for the treatment of poisoning by susceptible organophosphorus nerve agents having anticholinesterase activity as well as organophosphorus or carbamate insecticides in adults and pediatric patients weighing more than 41 kg (90 pounds).
- An anti-sialagogue when reductions of secretions of the respiratory tract are needed.
- It is used to prevent vagal stimulation prior to procedures in, prolonged cardiac arrest.

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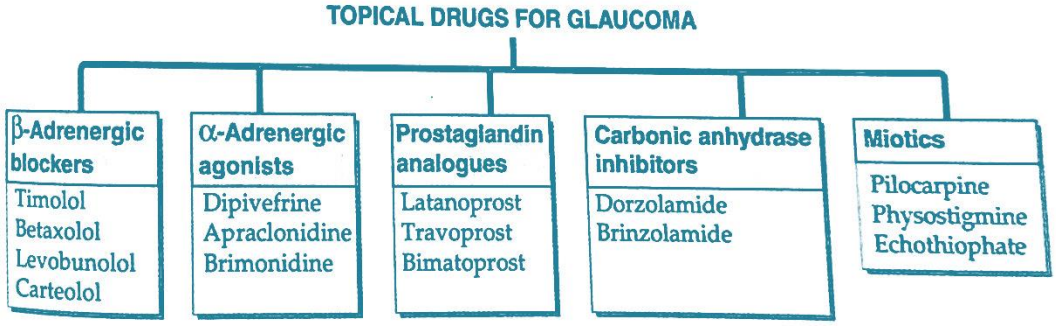
Contraindication

- Atropine generally is contraindicated in patients with glaucoma, pyloric stenosis, thyrotoxicosis, fever, urinary tract obstruction and ileus.

Drugs used in Glaucoma:

- Glaucoma is a group of diseases characterized by a progressive form of optic nerve damage.



Timolol

- Timolol is a non-selective beta adrenergic blocker used in the treatment of elevated intraocular pressure in ocular hypertension or open angle glaucoma.
- This medication is used to treat high pressure inside the eye due to glaucoma (open angle-type) or other eye diseases (such as ocular hypertension).
- Lowering high pressure inside the eye helps to prevent blindness. This medication works by decreasing the amount of fluid within the eye.

Pharmacological Action of Timolol

Timolol

↓

Binds to beta-adrenergic receptors, and block endogenous adrenergic stimulation

↓

Prevents the production of aqueous humor

↓

Lowers the ocular pressure inside the eye

Indication

- Ophthalmic timolol is indicated for the treatment of increased intraocular pressure in patients with ocular hypertension or open-angle glaucoma.
- The oral form of this drug is used to treat high blood pressure.
- In certain cases, timolol is used in the prevention of migraine headaches.

Contraindication:

- overactive thyroid gland
- diabetes
- low blood sugar
- myasthenia gravis, a skeletal muscle disorder
- complete heart block
- partial heart block
- sinus bradycardia

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Chapter -4 | | Drugs acting on the CNS |

Drugs Acting on the Central Nervous System Definition, classification, pharmacological actions, dose, indications and contraindications of

Unit-1

- General anaesthetics
- Hypnotics and sedatives
- Anti-Convulsant drugs
- Anti-anxiety drugs
- Anti-depressant drugs
- Anti-psychotics
- Nootropic agents
- Centrally acting muscle relaxants
- Opioid analgesics

General anaesthetics:

General anaesthetics (GAS) are drugs which produce reversible loss of all sensation and consciousness. The cardinal features of general anesthesia are:

- Loss of all sensation, especially pain
- Sleep (unconsciousness) and amnesia
- Immobility and muscle relaxation
- Abolition of somatic and autonomic reflexes.

Stage of General anaesthetics:

- General anaesthetics cause an irregularly descending depression of the CNS.
- The higher functions are lost first and progressively lower areas of the brain are involved but in the spinal cord lower segments are affected somewhat earlier than the higher segments.
- The description of these stages still serves to define the efforts of light and deep anesthesia.

Important features of different stages are -

Stage I

- **Analgesia state:** Patient is conscious and rational, with decreased perception of pain.

Stage-II

- **Delirium stage:** Patient is unconscious; body responds reflexively; irregular breathing pattern with breath holding.

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Stage-III

- **Surgical anesthesia:** Increasing degrees of muscle relaxation; unable to protect airway.

Stage IV

- **Medullary depression:** There is depression of cardiovascular and respiratory centers.

Properties of an ideal anesthetic

A. For the patient

- It should be pleasant, non-irritating, should not cause nausea or vomiting. Induction and recovery should be fast with no after effects.

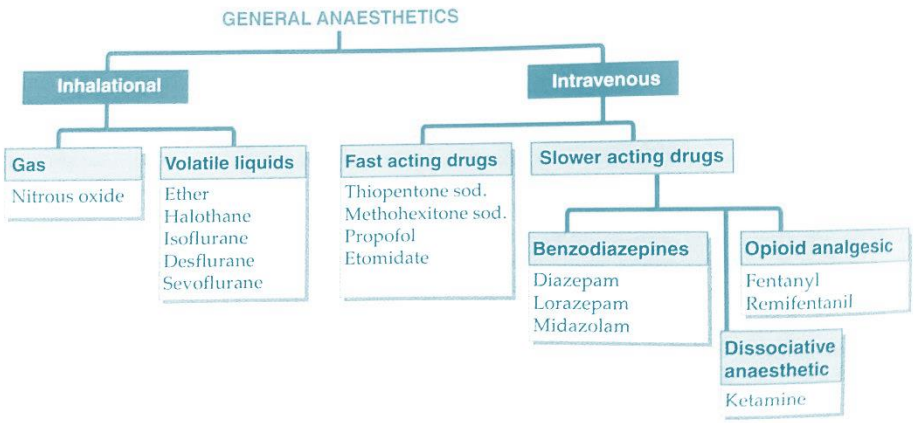
B. For the surgeon

- It should provide adequate analgesia, immobility and muscle relaxation. It should be noninflammable and non-explosive so that cautery may be used.

C. For the anesthetist

- Its administration should be easy, controllable and versatile.
- Margin of safety should be wide-no fall in BP. Heart, liver and other organs should not be affected.
- It should be potent so that low concentrations are needed and oxygenation of the patient does not suffer.
- Rapid adjustments in depth of anesthesia should be possible.
- It should be cheap, stable and easily stored. It should not react with rubber tubing or soda lime.

Classification of General anaesthetics:



Halothane (Fluothane)

- It is a volatile liquid with sweet odor, nonirritant and non in flammable. Solubility in blood is moderate induction is reasonably quick and pleasant.
- It is not a good analgesic or muscle relaxant, but it potentiates competitive neuromuscular blockers.
- Halothane causes direct depression of myocardial contractility by reducing intracellular Ca2+ concentration. Moreover, sympathetic activity fails to increase reflex.

- Cardiac output is reduced with deepening anesthesia.

Pharmacology Action:

- Halothane causes general anaethesia due to its actions on multiple ion channels, which ultimately depresses nerve conduction, breathing, cardiac contractility.
- Its immobilizing effects have been attributed to its binding to potassium channels in cholinergic neurons.
- Halothane's effect are also likely due to binding to NMDA and calcium channels, causing hyperpolarization.

Dose:

2-4% and for main tenance 0.5-1% is delivered by the use of a special vapourizer.

Indications:

- Halothane is a frequently used anaesthetic in developing countries, because it is relatively cheap and nonirritant, noninflammable, pleasant with relatively rapid action.
- It is particularly suitable for use in children, both for induction as well as maintenance.
- In adults, it is mainly used as a maintenance anaesthetic after i.v. induction.

Contraindications

Relatively greater depression of respiration. Breathing is shallow and rapid-PP of CO, in blood rises if respiration is not assisted. Cerebral blood flow increases.

Benzodiazepines (BZDs)
In addition to pre-anaesthetic medication, BZDs are now frequently used for inducing, maintaining and supplementing anaesthesia as well as for 'conscious sedation'.

Pharmacological actions Benzodiazepines

Benzodiazepines work by enhancing a very important neurotransmitter called GABA (gamma-aminobutyric acid) at the GABA A receptor. This results in the sedative, hypnotic (sleep-inducing), anxiolytic (anti-anxiety), anticonvulsant, and muscle relaxant properties

Dose Diazepam:

5 to 25 mg three times a day-four times a day Maximum 40 mg/day.

Indications:

Indications for benzodiazepine administration include, but are not limited to, anxiety disorders, insomnia, acute status epilepticus, induction of amnesia, spastic disorders, seizure disorders, and agitation.

Contraindications:

Common Contraindications

- Sedation,
- Dizziness,
- Weakness, and
- Unsteadiness.

Other side effects include: transient drowsiness commonly experienced during the first few days of treatment,

- A feeling of depression,
- Loss of orientation,
- Headache,
- Sleep disturbance,
- Confusion,
- Irritability,
- Aggression,

Noteskarts

Sedative & Hypnotic

Sedative

- A drug that subdues excitement and calms the subject without inducing sleep, though drowsiness may be produced.

- Sedation refers to decreased responsiveness to stimulation; is associated with some decrease in alertness, ideation and motor activity.

Or

- Sedative:- These are the drug which reduce excitement or slow down the current physical activity.

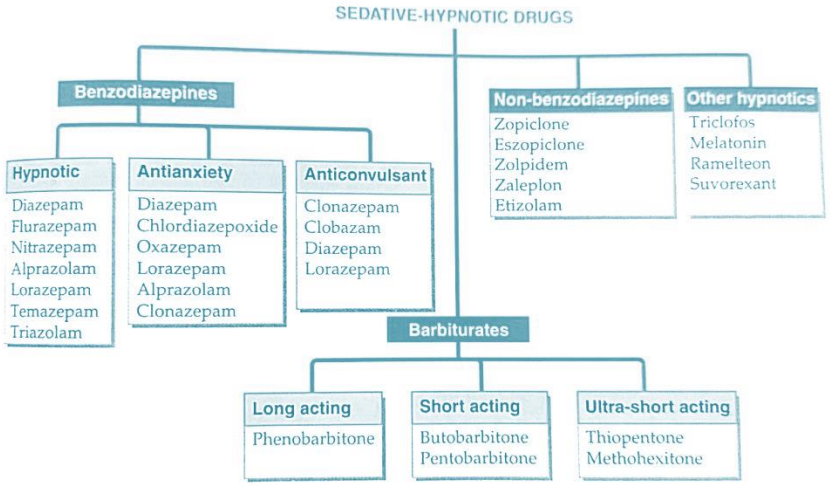
Hypnotic:

- A drug that induces and/or maintains sleep, similar to normal arousable sleep.
- This is not to be confused with 'hypnosis' meaning a trans-like state in which the subject becomes passive and highly suggestible.

Or

- Hypnotic:- These are the agent that induce sleep resembling natural sleep.

Classification of Sedative and Hypnotics



Diazepam:

- It is the oldest and all-purpose BZD, used as anxiolytic, hypnotic, muscle relaxant, premedicant, anaesthetic and for emergency control of seizures due to its broad spectrum activity.
- Because of rapid oral absorption, it can be used for sleep onset difficulty as well as for sleep maintenance.

Pharmacological actions of Diazepam

- It generates active metabolites (desmethyl-diazepam, oxazepam). On occasional use it is free of residual effects. With regular use accumulation occurs and prolonged anxiolytic effect may be obtained.

Dose of Diazepam in Hypnotic

- 5-10 mg

Dose of Diazepam in Sedative

- 5-10 mg IV 1-2 hours before surgery; 0.03-0.1 mg/kg q30min to 6hr

Indications

- This medication is a benzodiazepine, prescribed for anxiety. It is also used for muscle spasms and seizures.
- It works by acting on receptors in the brain called GABA receptors.
- Chronic insomnia
- Anxiety
- It is less likely to cause rebound insomnia on discontinuation of chronic use. Withdrawal phenomena are mild.

Contraindications of Diazepam

- Contraindicated in patients with increased eye pressure and hypersensitivity.

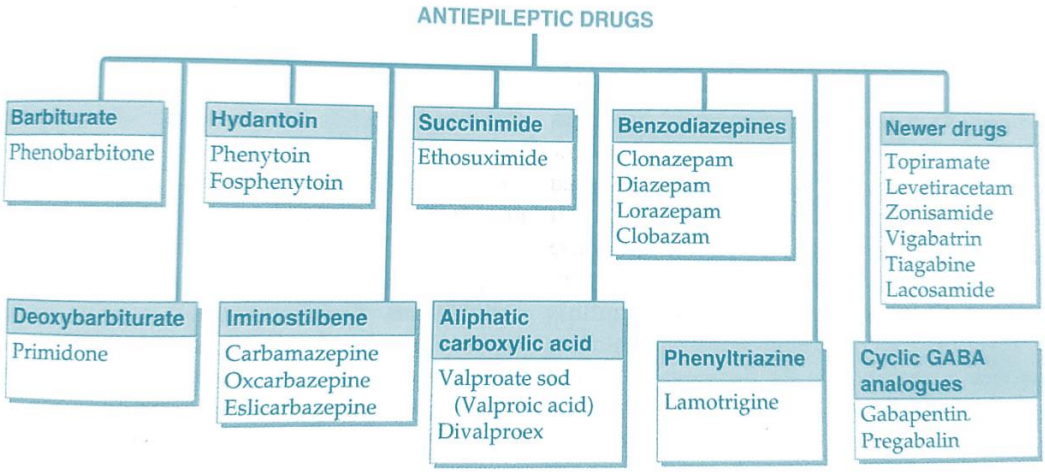
Noteskarts

Anti-Convulsants drugs (Anti-epileptic drugs)

Anticonvulsants are a diverse group of pharmacological agents used in the treatment of epileptic seizures.

Anticonvulsants are also increasingly being used in the treatment of bipolar disorder and borderline personality disorder, since many seem to act as mood stabilizers, and for the treatment of neuropathic pain.

Classification of Anti-Convulsants drugs



Phenytoin

- Phenytoin is in a class of medications called anticonvulsants.
- Phenytoin is used to control certain type of seizures, and to treat and prevent seizures that may begin during or after surgery to the brain or nervous system.
- It works by decreasing abnormal electrical activity in the brain.

Pharmacological actions of Phenytoin

- Phenytoin is often described as a non-specific sodium channel blocker and targets almost all voltage-gated sodium channel subtypes.
- More specifically, phenytoin prevents seizures by inhibiting the positive feedback loop that results in neuronal propagation of high frequency action potentials.

Dose of Phenytoin

Capsule, immediate-release

- 30mg
- 100mg

Capsule, extended-release

- 100mg
- 200mg

Indication

- Phenytoin is indicated to treat grand mal seizures, complex partial seizures, and to prevent and treat seizures during or following neurosurgery.

- Epilepsy
- Status epilepticus
- Neuropathic pain
- Choreoathetosis
- Myotonia

Contraindication:

Hypersensitivity to phenytoin or other hydantoins. Because of its effect on ventricular automaticity, IV phenytoin is contraindicated in sinus bradycardia, sinoatrial block, second and third-degree AV block, patients with Adams-Stokes syndrome..

Noteskarts

Anti-anxiety drugs

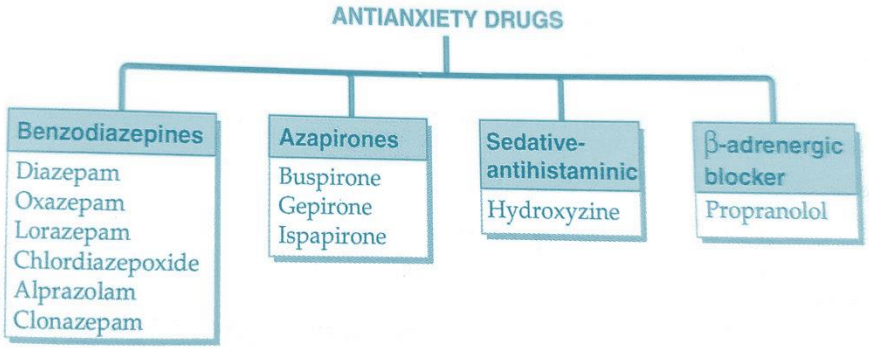
Definition of Anxiety:

- It is an emotional state, unpleasant in nature, associated with uneasiness, discomfort and concern or fear about some defined or undefined future threat.
- Somatic symptoms like anorexia, breathlessness, palpitation, paresthesia, etc. often accompany.
- Some degree of anxiety is a part of normal life.

Anti-anxiety drugs

- These are an ill-defined group of drugs, mostly mild CNS depressants, which are aimed to control the symptoms of anxiety, produce a restful state of mind with out interfering with normal mental or physical functions.
- The anxiolytic-sedative drugs differ markedly from antipsychotics, and more closely resemble sedative-hypnotics.

Classification of Anti-anxiety drugs



Alprazolam

- Alprazolam is used to treat anxiety and panic disorders. It belongs to a class of medications called benzodiazepines which act on the brain and nerves (central nervous system) to produce a calming effect.
- It works by enhancing the effects of a certain natural chemical in the body (GABA).

Pharmacological Action of Alprazolam

Alprazolam is a benzodiazepine. Benzodiazepines presumably exert their effects by binding at stereo specific receptors at several sites within the central nervous system at the GABA receptor complex. All benzodiazepines cause a dose-related central nervous system depressant activity.

Dose

- 0.25-1.0 mg TDS up to 6 mg/day in panic disorder.

Indication:

- Anxiety disorder
- Panic disorder
- Sedative

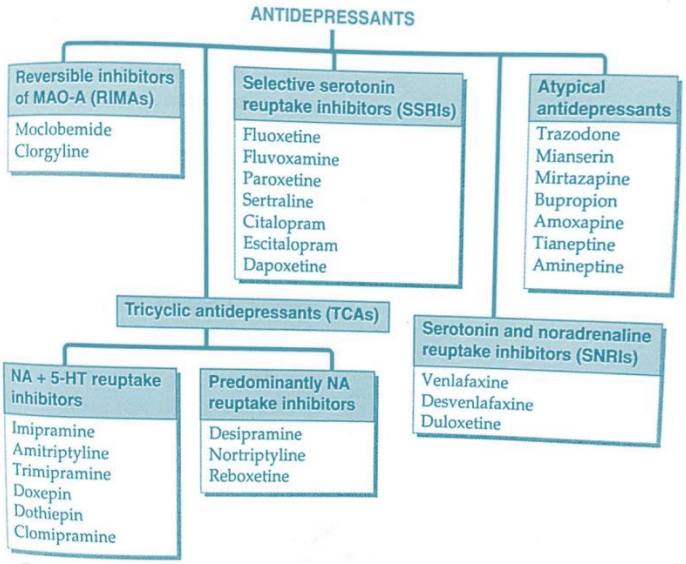
Contraindications:

- Respiratory depression, especially seen with coexistent respiratory disease or myasthenia gravis.
- There is potential for growing dependence, therefore only short-term recommended. use is
- Acute porphyria.
- Narrow-angle glaucoma.

Anti-depressant drugs

- These are drugs which can elevate mood in depressive illness.
- Practically all antidepressants affect monoaminergic transmission in the brain in one way or the other, and many of them have other associated properties.
- Over the past three decades, a large number of antidepressants with an assortment of effects on reuptake/metabolism of biogenic amines.

Classification of Anti-depressant drugs



Escitalopram.

- Escitalopram belongs to a class of drugs known as selective serotonin reuptake inhibitors (SSRIs)
- Escitalopram is used to treat depression and anxiety. It maintains the serotonin level in the brain which is responsible for the anxiety or depression.

Pharmacological action of Escitalopram:

Escitalopram binds with the site of the serotonin transporter (Primary and allosteric site) while other SSRIs and SNRI binds only with primary site. So, it gave the more advantage for managing the anxiety disorder, recently it is commonly use.

Dose:

Tablets- 5mg, 10mg, 20mg

Oral solution-5mg/5ml.

Indication:

Anxiety and depression.

Contraindications- Long term use of these drug may cause the sexual impotency and ejaculation disorders.

Insomnia, sedation also may occur.

Noteskarts

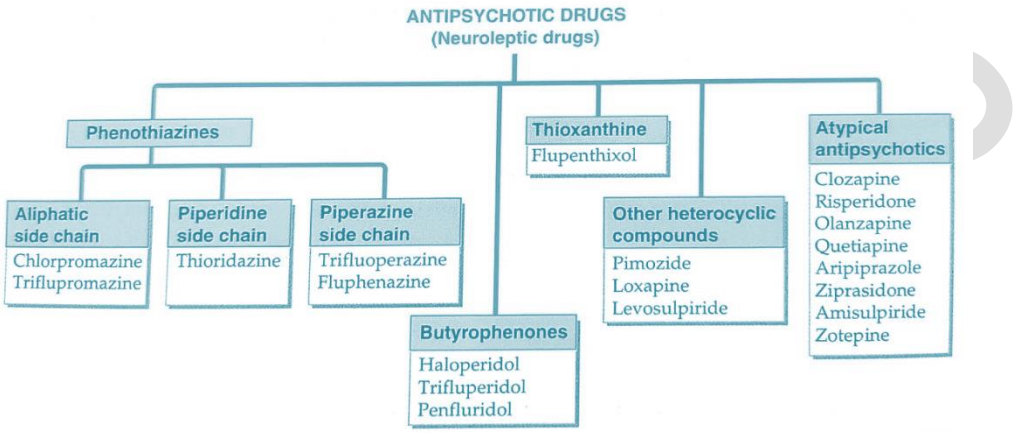
Anti-psychotics

Anti-Psychotic

Antipsychotics, also known as neuroleptics are a class of psychotropic medication primarily used to manage psychosis (including delusions, hallucinations, paranoia or disordered thought), principally in schizophrenia but also in a range of other psychotic disorders.

Classification of Anti-Psychotic drugs

These are drugs having a salutary therapeutic effect in psychoses.



Chlorpromazine

- Chlorpromazine is a member of the typical antipsychotic or neuroleptic drug class, also known as first-generation antipsychotics (FGAs).
- Chlorpromazine is a phenothiazine (FEEN-oh-THYE-a-zeen) that is used to treat psychotic disorders such as schizophrenia or manic-depression in adults.
- Chlorpromazine is also used in adults to treat nausea and vomiting, anxiety before surgery, chronic hiccups, acute intermittent porphyria, and symptoms of tetanus.

Pharmacological Action

- The post-synaptic blockade at the D2 receptors in the mesolimbic pathway. However, the blocking of D2 receptors in the nigrostriatal pathway is responsible for its extrapyramidal side effects.
- The antiemetic effect of chlorpromazine stems from the combined blockade of histamine H1, dopamine D2, and muscarinic M1 receptors in the vomiting center.
- Chlorpromazine is extensively metabolized by the liver (CYP450 enzymes A12 and 2D6; it is a CYP3A4 substrate.) It also undergoes metabolism in the kidney and GI tract. It is excreted in the urine, bile, and feces. It has a half-life of between 23 and 37 hours for the parent drug, and its active metabolite has a half-life of 10 to 40 hours.

Dose

- **Tablet:** 10, 25, 50, 100 mg

- **Syrup:** 5 mg/5 ml and 25 mg/5 ml
- **Injection:** 50 mg/2 ml

Indications:

- Chizophrenia (primarily the positive symptoms)
- Bipolar I acute manic type of manic-depressive illness.
- Acute agitation marked by explosive hyperexcitable behavior out of proportion to the initial provocation.
- To control nausea and vomiting, including intraoperative nausea and vomiting.

Contraindication:

- Hypersensitivity or allergy to phenothiazines.
- Pheochromocytoma.
- Breast cancer.
- A condition with low thyroid hormone levels.
- Low levels of parathyroid hormone.
- A high prolactin level.
- Overweight.
- Decreased function of bone marrow.

Nootropic agents

Drugs used to specifically facilitate learning or memory, particularly to prevent the cognitive deficits associated with dementias.

These drugs act by a variety of mechanisms. While no potent nootropic drugs have yet been accepted for general use, several are being actively investigated.

Classification Nootropic agents

- **RACETAM (piracetam,oxiacetam) -piracetam is first nootropic agent discovered**
- **Choline (Acetylcholine Precursors)-(lecithin)**
- **Acetyl cholinesterase Inhibitors (Over-The-Counter)**
  - Huperzine A

- **Ampakines (aniracetam)**
- **Herbal**
  - Bacopa Monneri
  - Vinpocetine Gingko biloba
  - Rhodiola rosea
  - Mucuna pruriens - precursor to dopamine
  - Gotu Kola
- **Other Nootropics**
  - Sulbutiamine(vitamin bı derivative)
  - Pyritinol
  - Citicholine
  - L-theanine
  - Picamilon
  - Phenylethylamine (PEA)
  - noopept(peptide)
  - Dihydroergotoxine Piribedil

Choline

- Choline is a nutrient found in a wide variety of vitamins including pre-natal formulations.

Phenylethylamine

- Phenethylamine is a chemical that is found naturally in the body. It can also be made in the laboratory.
- Phenethylamine is used for athletic performance, depression, weight loss, and to improve mood and attention, but there is no good scientific evidence to support these uses.

Pharmacological Action

- In the brain, phenethylamine regulates monoamine neurotransmission by binding to trace amine-associated receptor 1 (TAAR1) and inhibiting vesicular monoamine transporter 2 (VMAT2) in monoamine neurons.
- To a lesser extent, it also acts as a neurotransmitter in the human central nervous system.
- In mammals, phenethylamine is produced from the amino acid L-phenylalanine by the enzyme aromatic L-amino acid decarboxylase via enzymatic decarboxylation.

Dose

- Phenylethylamine (PEA) suggested dosage for cognitive benefit is 500 mg up to 3-times per day.

- PEA has a half-life of 5 – 10 minutes. But the effects of PEA can be extended by using it with a MAO-B inhibitor.
- If you do use a potent MAOI like selegiline (l-deprenyl) make sure you keep the dose low (i.e. 2.5 mg).

Indication

- Depression
- Anxiety
- Neuroprotector
- Attention Deficit Disorder (ADHD)

Contraindication

- Headache, heart problems, shivering, confusion, and anxiety.

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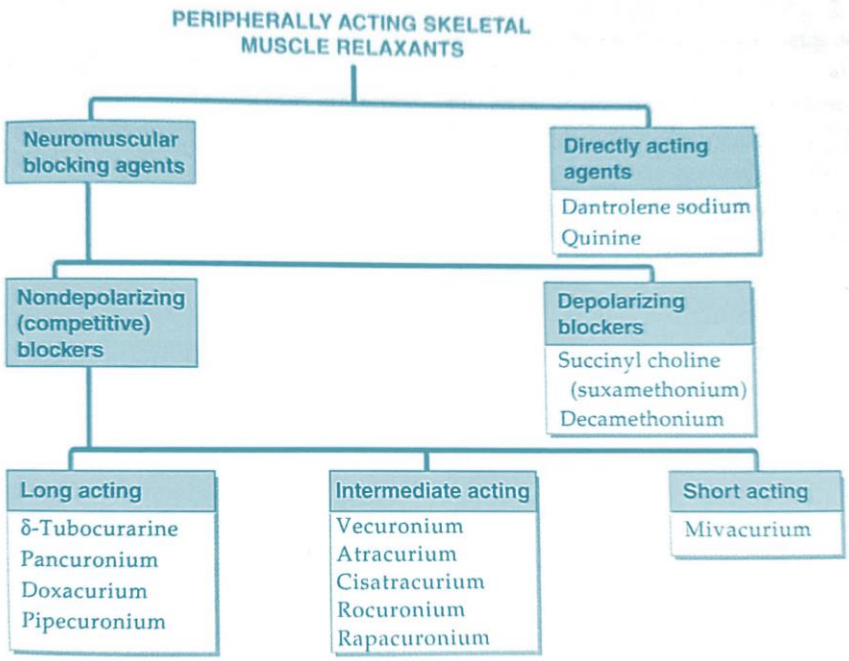
Centrally acting muscle relaxants

- Muscle relaxants, also known as myorelaxants, are a large group of chemical compounds that have the ability to relax skeletal muscle.
- These are a separate class of drugs used during intubations and surgery to reduce the need for anesthesia and facilitate intubation. Skeletal muscle relaxants are also used for relief of spasticity in neuromuscular diseases.

Or

- Skeletal muscle relaxants are drugs that act peripherally at neuromuscular junction/muscle fibre itself or centrally in the cerebrospinal axis to cause paralysis or reduce muscle tone.
- The neuromuscular blocking agents are used primarily in conjunction with general anaesthet ics to provide muscle relaxation for surgery, while centrally acting muscle relaxants are used mainly for painful muscle spasms and spastic neurological conditions.

Classification of Centrally acting muscle relaxants



d-Tubocurarine

- Tubocurarine is a non-depolarizing neuromuscular blocker. Non-depolarizing neuromuscular blockers interfere with the NM transmission. D-tubocurarine is a natural substance, obtained from curare, which was used in ancient times as an arrow head poison to kill animals.

Pharmacological Action

1. Release of histamine (premedication with antihistaminics is useful, otherwise hypotension might occur)
2. Causes weak blockage of ganglion
3. Blocks adrenal medulla

Dose

- 5-15 or 20 mg dose are available.
- Dose should not exceed 400 mg.

Indication

- Hypotension (because of histamine release and ganglion blockage, vasodilatation)
- Bronchospasm (histamine release)
- Rash (histamine)
- Vomiting (paralysis of sphincters and diplopia can be there due to paralysis of muscles)

Contraindication

- Respiratory insufficiency –emphysema, bronchial asthma
- Renal disease

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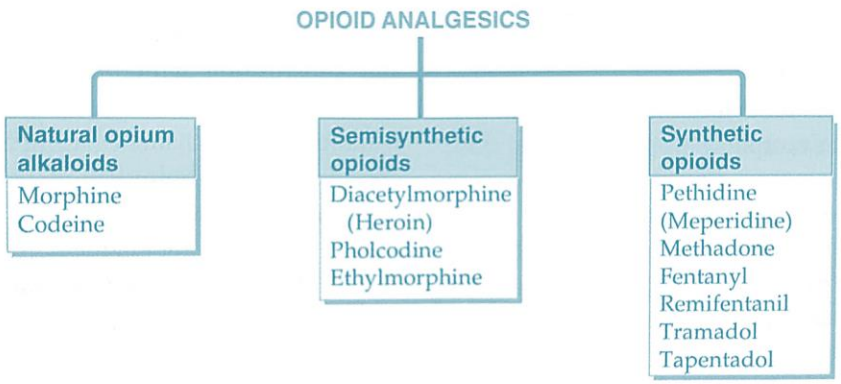
Opioid analgesics

- Opium a dark brown, resinous material obtained from poppy (Papaver somniferum) capsule.
- A pharmacist, isolated the active principle of opium in 1806 and named it 'morphine' after the Greek god of dreams Morpheus. In the last century a large number of semisynthetic and synthetic compounds have been developed with morphine-like, antagonistic and mixed agonistic-antagonistic properties.
- Compounds that are derived from opium or are chemically related to morphine are called 'opiates', while all those having morphine-like action, irrespective of chemical nature, are called 'opioids'.

Classification of Opioid Analgesics



Morphine:

- Morphine may be habit forming, especially with prolonged use. Take morphine exactly as directed.
- Morphine is an opioid agonist used for the relief of moderate to severe acute and chronic pain.

Pharmacological Action

Morphine is in a class of medications called opiate (narcotic) analgesics. It works by changing the way the brain and nervous system respond to pain.

Dose

Tablet, extended-release (MS Contin): Schedule II

- 15mg, 30mg, 60mg, 100mg, 200mg

SC/IM (opioid-naïve patients):

- 5-10 mg q4hr PRN; dose range, 5-20 mg

IV (opioid-naïve patients):

- 2.5-5 mg q3-4hr PRN, infused over 4-5 minutes; dose range, 4-10 mg

Indication

- Morphine is used for the management of chronic, moderate to severe pain.
- Musculoskeletal pain
- Abdominal pain
- Chest pain
- Arthritis, and even headaches

Contraindication

Nausea, vomiting, constipation, lightheadedness, dizziness, drowsiness, increased sweating, or dry mouth may occur.

Note: Codeine, Diacetylmorphine (Heroin), Ethylmorphine are also Important Drugs for Exam Point of View So read yourself

Thank You

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Chapter-5 | Pharmacology | Drugs Acting on the Cardiovascular System

Drugs Acting on the Cardiovascular System Definition, classification, pharmacological actions, dose, indications and contraindications of

- Anti-hypertensive drugs
- Anti-anginal drugs
- Anti-arrhythmic drugs
- Drugs used in atherosclerosis
- Congestive heart failure

Anti-hypertensive drugs

- These are those drugs which are used to in the treatment of Hypertension.

Hypertension

- Hypertension is define as either a sustained systolic BP of greater then 140 mmHg or sustained diastolic BP of greater than 40mmHg.

Or

- It is a condition of elevated blood pressure in our body (High Blood Pressure).

$$\text{Normal} = \frac{120}{80} = \frac{\text{Systolic}}{Diastolic}$$

Stage of Hypertension:

Hypertension	Systolic	Diastolic
Stage-I	140-159	90-99
Stage-II	160-179	100-109
Severe	>180	>110

Hypertension Can Cause

- Heart Failure
- Brain Stroke
- Kidney Failure
- Vision loss

- Sexual dysfunction

Risk Factor

- NA+ Intake ↑
- Smoking ↑
- Stress ↑
- Obesity ↑

Anti-hypertensive drugs

- These are those drugs which are used to in the treatment of Hypertension.

Or

- The antihypertensives of the 1960-70s were methyldopa, B blockers, thiazide and high ceiling diuretics and clonidine.
- The status of ß blockers and diuretics was consolidated in the 1970s and selective α, blocker prazosin broke new grounds.
- The antihypertensives introduced in the 1980-90s were angiotensin II converting enzyme (ACE) inhibitors and calcium channel blockers.
- Angiotensin receptor blockers (losartan, etc.) were added soon after, and the direct renin inhibitor aliskiren is the latest drug.

Classification Anti-hypertensive drugs:

1. **Diuretics**
    - Furosemide
    - Thiazides
    - Eplerenone, etc.
2. **ACE Inhibitors**
    - Captopril
    - Lisinopril
    - Quinapril, etc.
3. **Beta Adrenergic blocker**
    - Atenolol
    - Metoprolol
    - Propranolol, ect.
4. **Calcium Channel Blockers**
    - Verapamil
    - Diltiazem
    - Nifedipine
    - Felodipine, etc.

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5. **Vasodilators**
    - Sodium Nitroprusside
    - Diazoxide
    - Minoidil, etc.

- **Diuretics:**

  Mechanism of Action of diuretics is based upon decreasing blood volume which ultimately leads to decrease blood pressure.

  Thiazide diuretics:
    - Thiazide diuretics are mainly used to treat high blood pressure (hypertension). They are occasionally also used for heart failure.
    - When used to treat heart failure they are often combined with another type of medicine called a loop diuretic.

  Pharmacological Action:
    - Their action is to make the kidneys pass out more fluid.
    - They do this by interfering with the transport of salt and water across certain cells in the kidneys.
    - Thiazide diuretics tend to have only a weak action on the kidneys so you don't notice a great increase in urine if you take these (compared with loop diuretics).
    - They also have the effect of widening (dilating) blood vessels. A combination of these two effects reduces the blood pressure.

  Dose
    - Tablet
    - 15 mg
    - 25 mg
    - 50 mg

  Indications
    -

  Contraindications
    - Blood sugar level
    - Increase in the level of uric acid
    - Upset stomach.
    - Dizziness on standing

- **ACE Inhibitors**

These drugs block the enzyme ACE (Angiotensin Converting Enzyme) which convert Angiotensin-I to Angiotensin-II (Vasoconstrictor).

Examples of ACE inhibitors include:

- Benazepril (Lotensin) (20 to 40 mg per day)
- Captopril (Table:-12.5 mg, 25 mg, 50 mg, 100 mg)
- Enalapril (Vasotec)
- Fosinopril
- Lisinopril (Prinivil, Zestril)
- Moexipril
- Perindopril
- Quinapril (Accupril)
- Ramipril (Altace)
- Trandolapril

Pharmacological Actions:

ACE Inhibitors decrease angiotensin-II & Increase bradykinin levels vasodilators of both arteries and veins occurs as a results of decreasing vasoconstriction (Due to decreasing in Angiotensin-II) & enhanced vasodilation (from ↑ bradykinin levels).

Indication:

- Migraines
- High blood pressure (hypertension)
- Coronary artery disease
- Heart failure
- Diabetes
- Certain chronic kidney diseases
- Heart attacks

Contraindication

- Dry cough
- Increased potassium levels in the blood (hyperkalemia)
- Fatigue
- Dizziness from blood pressure going too low
- Headaches
- Loss of taste

Anti-anginal drugs

- These are those that prevent or terminate attacks of angina pectoris.

Angina Pectoris:

- It is a pain syndrome due to induction of an adverse oxygen supply/ demand situation in a portion of the myocardium. Metabolites that accumulate due to myocardial ischaemia elicit the pain.
- It is also known as ischemic chest pain.

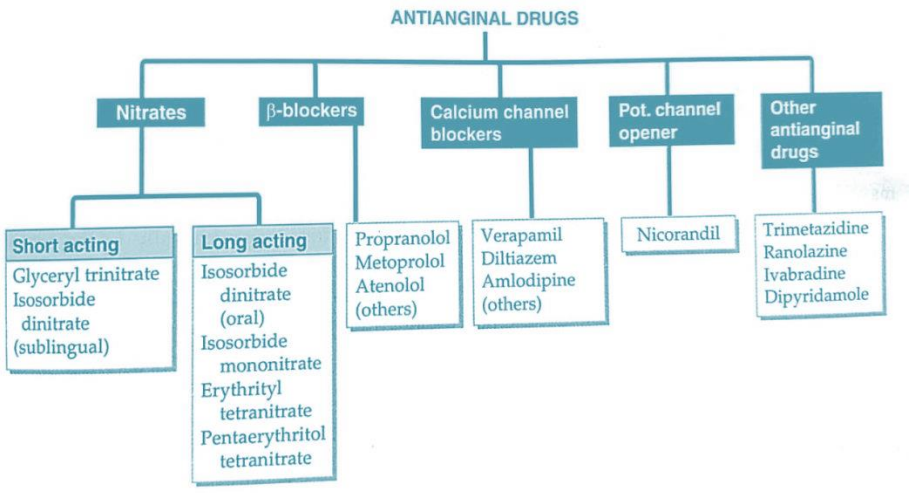
Cause:

- Less O2 supply in heart.
- Less O2 demond in heart.
- Less blood supply in heart.

Reason:

- Coronary artery disease (CAO)
- Vasospasm of coronary arteries.

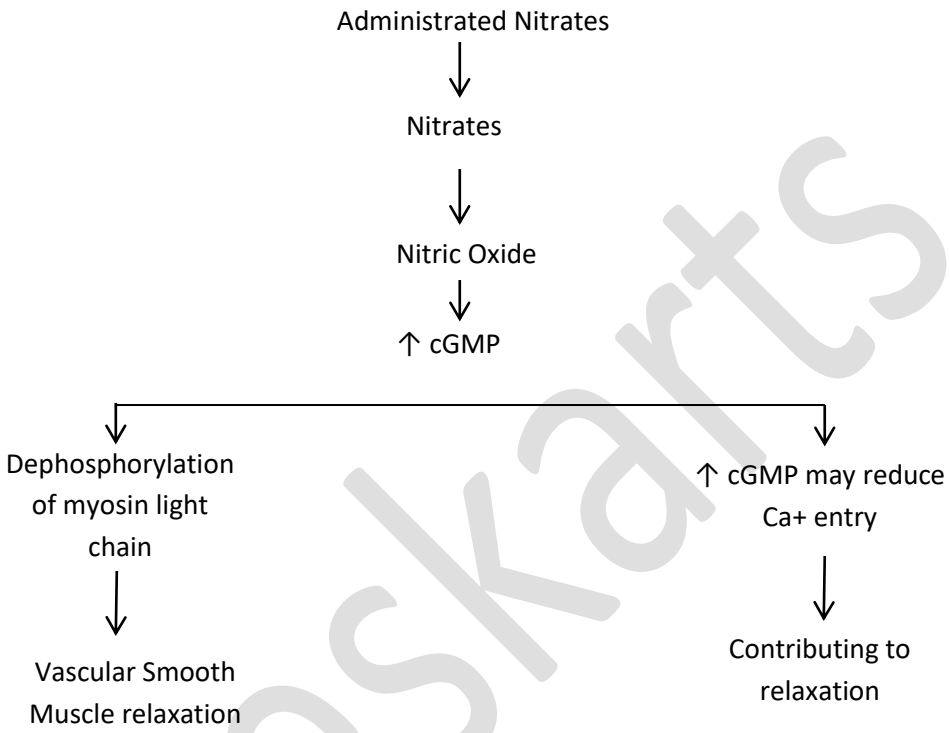
Classification of Anti-anginal drugs:



Nitrates:

- All organic nitrates share the same action differ only in time Course.
- The major action is direct nonspecific smooth muscle relaxation, particularly vascular smooth muscle.

Pharmacological Action:



Dose:

Drugs	Dose
GTN (Nitroglycerine)	• 0.5 mg sublingual • 0.4—0.8 mg s.l. spray • 5-15 mg SR oral • One patch for 14—16 hr per day • 5—20 pg/min i.v.
Isosorbide dinitrate	• 5 mg sublingual • 10—20 mg oral • 10—40 mg SR oral
Erythrityl-tetranitrate	• 15—60 mg oral

Indications:

- Angina pectoris
- Congestive heart failure
- Stroke (damage to brain tissue caused by obstruction to the blood flow)

Contraindications:

- Headache
- Dizziness
- Nausea
- Lightheadedness
- Restlessness
- Stomach discomfort
- Hypotension (low blood pressure)

Beta Blockers

- The β-blockers decrease the oxygen demand of the myocardium by blocking β1, resulting in decreasing heart rate, contractility, cardiac output and blood pressure.
- These agents reduce the oxygen demand during exerting and at rest. They can reduces both the frequency & severity of angina attacks.

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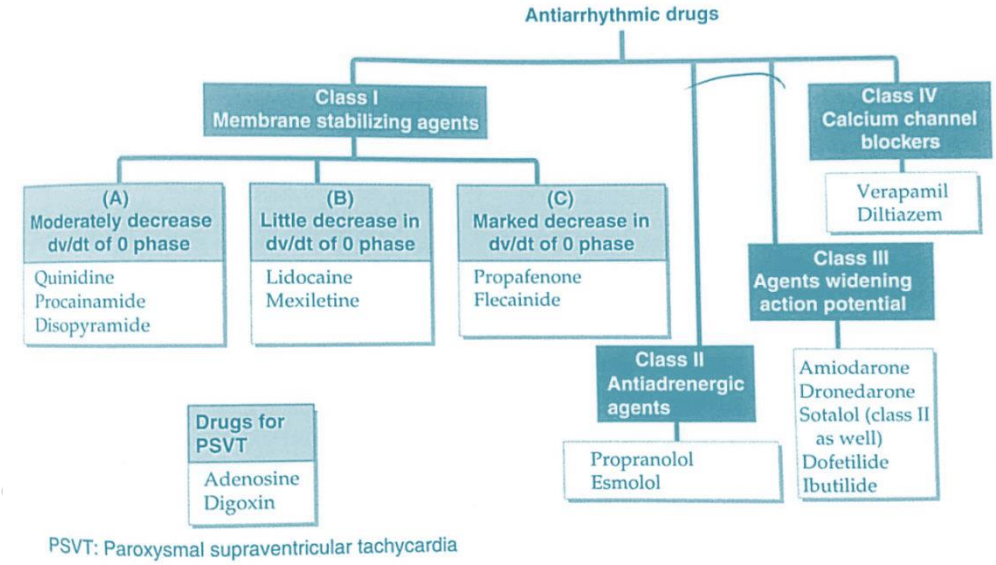
Anti-arrhythmic drugs

- These are drugs used to prevent or treat irregularities of cardiac rhythm.

Arrhythmias

- Arrhythmias are the most important cause of sudden cardiac death. However, only few arrhythmias need to be treated with antiarrhythmic drugs.
- Abnormal automaticity or impaired conduc tion or both underlie cardiac arrhythmias. The generation and propagation of cardiac impulse

Classification of Anti-arrhythmic drugs



Quinidine

- It is the dextro isomer of the antimalarial alkaloid quinine found in cinchona bark.
- Quinidine is used to treat certain types of irregular heartbeats. Quinidine is in a class of medications called antiarrhythmic medications.

Pharmacological Action of Quinidine:

- Quinidine blocks the rapid sodium channel (I_{Na}), decreasing the phase zero of rapid depolarization of the action potential.
- Quinidine also reduces repolarizing K^+ currents (I_{Kr}, I_{Ks}), the inward rectifier potassium current (I_{K1}), and the transient outward potassium current I_{to}, as well as the L-type calcium current I_{Ca} and the late I_{Na} inward current.
- The reduction of these currents leads to the prolongation of the action potential duration

Dose:

- Form: oral immediate-release tablet (200 mg and 300 mg)

Indications:

- irregular heartbeats
- Cardiac arrhythmias (paroxysmal supraventricular tachycardia, ventricular tachycardia pre-dysrhythmias)
- Treatment of severe malaria

Contraindications:

- Hypersensitivity.
- Thrombocytopenic purpura hx, quinidine or quinine-assoc.
- Myasthenia gravis, Intraventricular conduction defects, Complete AV block w/ junctional rhythm, Complete AV block w/idioventricular rhythm, ongenital long QT syndrome, uncorrected Electrolyte abnormalities.

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Drugs used in atherosclerosis and Congestive heart failure

Atherosclerosis

- Arteriosclerosis occurs when the blood vessels that carry oxygen and nutrients from the heart to the rest of the body (arteries) become thick and stiff sometimes restricting blood flow to the organs and tissues.
- Atherosclerosis is the buildup of fats, cholesterol and other substances in and on the artery walls. This buildup is called plaque.
- The plaque can cause arteries to narrow, blocking blood flow.
- The plaque can also burst, leading to a blood clot.

Symptoms

- Chest pain
- Weakness in your arms or legs
- High blood pressure or kidney failure

Drugs used in atherosclerosis

1. **Calcium channel blockers**— which block the calcium channels in myocardium and thereby, reduce the contractility of myocardium. Exphenylalkylamine, benzothiazepine, dihydropyridines.
2. **Vasodilators**— reduce the blood pressure by the vasodilation. Ex- sodium nitroprusside, hydralazine, minoxidil, fenoldopam, diazoxide.
3. **Diuretics**— diuretics cause diuresis and reduce the ECF volume and blood volume. Ex thiazide diuretics, loop diuretics, potassium-sparing diuretics, osmotic diuretics, and carbonic anhydrase inhibitors.
4. **Angiotensin converting enzyme inhibitors (ACE inhibitors)**— it reduce the blood pressure by blocking the formation of angiotensin.
5. **Angiotensin (AT1) receptor blocker—** Ex- losartan, telmisartan, melavinus, valsartan, eprosartan.
6. **Sympathetic inhibitors**—
    a) ***Alpha Beta adrenergic blockers***— arotinolol, labetalol, carvedilol, bucindolol.
    b) ***Alpha adrenergic blockers***— Prazosin, doxazosin, naftopidil, phenoxybenzamine.
    c) ***Beta adrenergic blockers***— Atenolol, metoprolol, timolol, oxprenolol, nipradilol.
    d) ***Central sympatholytics***— methyldopa, reserpine, clonidine.

Congestive heart failure.

- Heart failure or congestive heart failure is an abnormal condition involving impaired cardiac pumping. In this condition heart is fail to pump the sufficient blood to our organs due to the less nutrients and oxygen supply to the myocardial destruction (less ability of cardiac muscle).

Types of heart failure—

- **Left-sided heart failure**— Most common form of heart failure. Fluid may back up in your lungs, causing shortness of breath.

- **Right-sided heart failure**— often occurs with left sided heart failure. Failure may back up into your abdomen, legs and feet, causing swelling.
- **Systolic heart failure**—the left ventricle cannot contract vigorously indicating a pumping problem.
- **Diastolic heart failure**—the left ventricle cannot relax or fill fully, indicating a filling problem.
  - Congestive heart defects may be diagnosed before birth, right after birth, during childhood or not until adulthood. It is possible to have a defect and no symptoms at all.

Clinical manifestations ()

- Tachycardia
- Oedema (swelling in ankles, legs and abdomen).
- Cachexia and muscle wasting.
- Crepitations or wheeze.
- Third heart sound
- Hepatomegaly.
- Pulses alterations

Drugs used in Congestive heart failure

1. Calcium channel blockers— which block the calcium channels in myocardium and thereby, reduce the contractility of myocardium. Ex- phenylalkylamine, benzothiazepine, dihydropyridines.
2. Vasodilators— reduce the blood pressure by the vasodilation. Ex- sodium nitroprusside, hydralazine, minoxidil, fenoldopam, diazoxide.
3. Diuretics— diuretics cause diuresis and reduce the ECF volume and blood volume. Ex thiazide diuretics, loop diuretics, potassium-sparing diuretics, osmotic diuretics, and carbonic anhydrase inhibitors.
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   d) Central sympatholytics— methyldopa, reserpine, clonidine.

Drugs & Dose in atherosclerosis and Congestive heart failure

Drugs	Dose
Sodium nitroprusside	25mg/mL (50mg/2mL vial)
Losartan	Tablet • 25mg • 50mg • 100mg
Verapamil	Tablet • 40 mg • 80 mg • 120 mg

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Chapter-6 | Pharmacology

Drugs Acting on Blood and Blood Forming Organs

Definition, classification, pharmacological actions, dose, indications and contraindications of

- Hematinic agents
- Anti-coagulants
- Anti-platelet agents
- Thrombolytic drugs

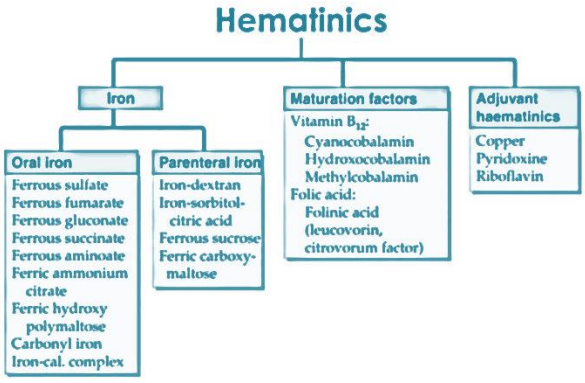
Drugs Acting on Blood and Blood Forming Organs

- Blood is a fluid connective tissue that transports oxygen, nutrients and growth factors to individual cells of the body.
- The main components of blood are cell (like RBCs, WBCs, platelets), proteins (like coagulation factors, amino acids, growth factors, factors of the complement system), monosaccharide (ribose, glucose), minerals (Na+, K+, Cl-, HCO3-), and water.

Hematinic agents :

- This medication is an iron supplement used to treat or prevent low blood levels of iron (such as those caused by anemia or pregnancy).

Classification:



Anaemia

- Anaemia is the decrease in number of red blood cells or hemoglobin content caused by blood loss, deficient erythropoiesis, excessive hemolysis, or combination of these changes. Iron deficiency anaemia is probably the most common nutritional deficiency in the world.
- Infants and young children have higher iron requirement.
- Adult women have higher iron requirement because of menstrual losses. During pregnancy it is not necessary to have extra iron in the diet because absorption increases and menstruation stops.
- The fetus is likely to get enough iron even if its mother has low stores, but mother becomes anaemic.

Iron:

- Iron helps red blood cells carry oxygen from the lungs to cells all over the body. Iron also plays a role in many important functions in the body.
- The body iron is distributed mainly in two forms, one as haem in haemoglobin and cytochrome oxidase enzyme and other as iron bound to protein as storage compounds ferritin and hemosiderin, and as transport iron bound to transferrin.
- The total iron in human adult is approximately 3.5g.

Pharmacological actions

- Iron is necessary for the production of hemoglobin. Iron-deficiency can lead to decreased production of hemoglobin and a microcytic, hypochromic anemia.

Dose of Iron		
Children	**7-12 months**	**11 mg/day**
	1-3 years	7 mg/day
	4-8 years	10 mg/day
	9-13 years	8 mg/day
Males	**14-18 years**	**11 mg/day**
	19 years and up	8 mg/day
Females	**19-50 years**	**18 mg/day**
	51 years and over	8 mg/day
	Pregnant	27 mg/day
	Breastfeeding	Under 19 years: 10 mg/day 19 years and over: 9 mg/day

Indications

- Used in preventing and treating iron-deficiency anemia.
- Used in treatment of Fatigue

Contraindications:

- Stomach upset
- Nausea
- Vomiting.

Coagulants and Anticoagulants

Coagulants:

Thrombogenesis is an abnormal state of haemostasis leading to the formation of arterial and venous **thrombus, also known as white and red thrombus respectively.**

Haemostasis is the spontaneous arrest of bleeding from the damaged blood vessels.

Three basic measures taken by the body to reduce and stop blood loss are:

i) Vascular spasm.
ii) Platelet plugs formation.
iii) Clotting or coagulation.

Clotting:

- Coagulation, also known as clotting, is the process by which blood changes from a liquid to a gel, forming a blood clot. It potentially results in hemostasis.
- Normally, blood remains liquid as long as it is flowing within intact smooth blood vessels. But on damage to the blood vessel and/or if blood is extracted from the blood vessel.

Factor of Clotting:

- Fibrinogen
- Prothrombin
- Thromboplastin
- Plasma thomboplastin component
- Hageman factor

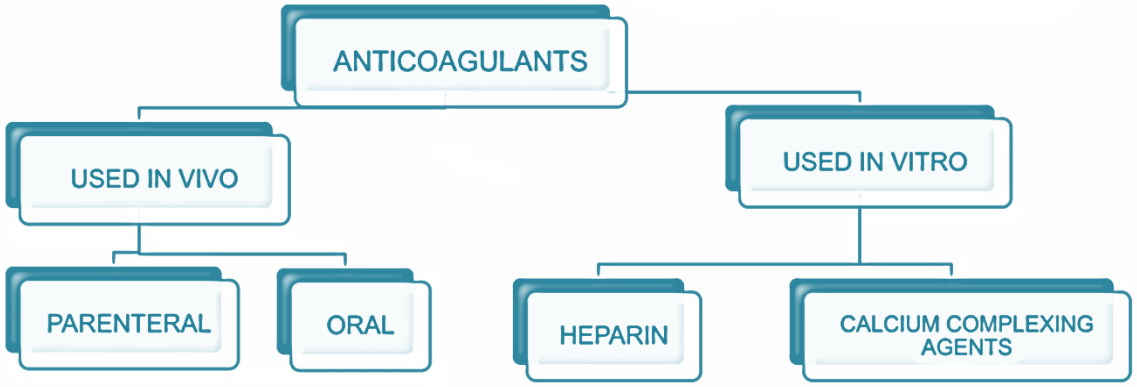
These are the agents that promote coagulation and are mainly used in any haemorrhagic condition.

- Vitamin K

Anticoagulants:

- These are the drugs used to reduce the coagulability of blood clots.
- They're given to people at a high risk of getting clots, to reduce their chances of developing serious conditions such as strokes and heart attacks.
- The most important anticoagulants is heparin.

Classification:



Heparin:

Heparin, also known as unfractionated heparin (UFH), is a medication and naturally occurring glycosaminoglycan.

Pharmacological Action of Heparin:

- Heparin is a sulfated polysaccharide with a molecular weight range of 3000 to 30 000 Da (mean, 15000 Da).
- It produces its major anticoagulant effect by inactivating thrombin and activated factor X (factor Xa) through an antithrombin (AT)-dependent mechanism.
- Heparin binds to AT through a high-affinity pentasaccharide, which is present on about a third of heparin molecules.
- For inhibition of thrombin, heparin must bind to both the coagulation enzyme and AT

Dose:

Intermittent IV injection

- 8000-10,000 units IV initially, THEN 50-70 units/kg (5000-10,000 units) q4-6hr

Continuous IV infusion

- 5000 units IV injection, followed by continuous IV infusion of 20,000-40,000 units/24 hr

Indicated:

- Bleeding
- Pain
- Low blood platelets.
- Thrombocytopenia.
- Greater care is needed in those with poor kidney function.

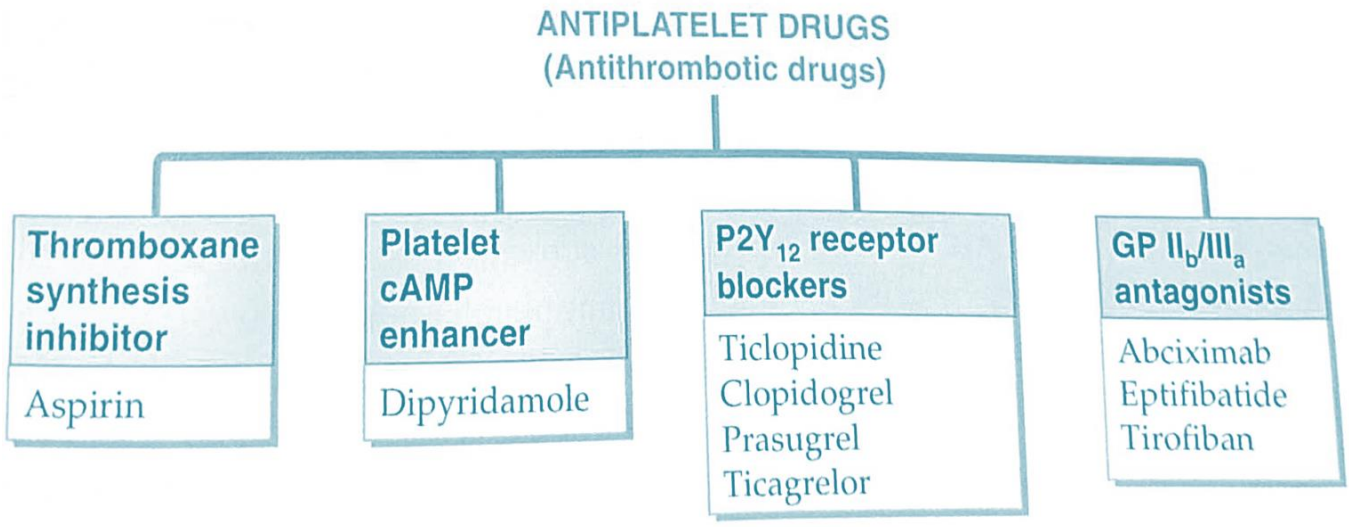
Contraindicated:

- Increase the risk of bleeding
- Uncontrolled blood pressure
- Liver disease
- Stroke
- Hypertension
- Chest pain
- Irregular heartbeats
- Shortness of breath
- Dizziness

Antiplatelet Agent (Antithrombotic drugs):-

- These are drugs which interfere with platelet function and are useful in the prophylaxis of thromboembolic disorders.
- **The major role** of **antiplatelet drugs** in clinical practice is to prevent the adverse clinical sequelae of thrombosis in atherosclerotic arteries to the heart (acute coronary syndromes [ACS]), brain (ischaemic stroke), and limbs (intermittent claudication and rest pain); and thrombosis of stagnant blood in veins (venous thromboembolism) and heart chambers (atrial fibrillation, heart failure).
- Antiplatelet medications, such as aspirin and clopidogrel, are commonly used to reduce the risk of heart attack.

Classification of Antiplatelet Drugs:



Aspirin

- Aspirin reduces the risk of serious vascular events in patients at high risk of such an event by about a quarter and is recommended as the first-line antiplatelet drug.

Pharmacological Action:

- Aspirin (acetylsalicylic acid) irreversibly inhibits prostaglandin H synthase (cyclooxygenase) in platelets and megakaryocytes, and thereby blocks the formation of thromboxane
- a potent vasoconstrictor and platelet aggregant).
- It is only the parent form, acetylsalicylic acid, which has any significant effect on platelet function. Because platelets are unable to regenerate cyclooxygenase, the immediate antithrombotic effect of aspirin remains for the lifespan of the platelet (8–10 days).
- As, after stopping aspirin therapy, normal haemostasis may be regained when about 20% of platelets have normal cyclooxygenase activity, daily aspirin intake is recommended.

Dose of Aspirin:

Tablet

- 81 mg
- 325 mg
- 500 mg

Indication

- Pain, fever, and inflammation.
- ASA is also indicated for various other purposes, due to its ability to inhibit platelet aggregation.
- Reducing the risk of cardiovascular death in suspected cases of myocardial infarction.

- For decreasing platelet to platelet adhesion following carotid endarterectomy, aiding in the prevention of transient ischemic attacks.

Contraindications:

- Hypertension.
- Upset stomach.
- Heartburn.
- Drowsiness.
- Mild headache.
- Severe nausea, vomiting, or stomach pain.
- Bloody or tarry stools, coughing up blood or vomit that looks like coffee grounds.
- Fever lasting longer than 3 days.
- Swelling, or pain lasting longer than 10 days.

Thrombolytic Drugs:

- Thrombolysis, also called fibrinolytic therapy, is the breakdown of blood clots formed in blood vessels, using medication.
- It is used in ST elevation myocardial infarction, stroke, and in cases of severe venous thromboembolism.

Pharmacological actions:

- Thrombolytic work by dissolving a major clot quickly.
- This helps restart blood flow to the heart and helps prevent damage to the heart muscle.
- Thrombolytic can stop a heart attack that would otherwise be larger or potentially deadly.

Classification of thrombolytic drugs

1. Non-fibrin specific
   - Streptokinase
   - Anistreplase
   - Urokinase
2. Fibrin specific
   - **Tissue plasminogen Activators (t-PA)**
     - Alteplase
     - Reteplase
     - Tenecteplase

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Dose:

Thrombolytic drug	Trial doses[15,33,34,36]
Streptokinase	
Load (30 minutes infusion)	1000–3000 U/kg
Maintenance	1000–2000 U/kg/hour
Alteplase	
Load (30 minutes to 1 hour infusion)	0.05–0.5 mg/kg/hour
Maintenance	0.1–0.25 mg/kg/hour
Urokinase	
Loading dose (bolus)	30,000–100,000 U
Maintenance	10,000–50,000 U/hour

Indication:

- Acute myocardial infarction (AMI)
- Deep vein thrombosis (DVT)
- Pulmonary embolism (PE)
- Acute ischemic stroke (AIS)
- Acute peripheral arterial occlusion.
- Occlusion of indwelling catheters.
- Intracardiac thrombus formation.
- Severe frostbite(off-label use)

Contraindications:

- Bleeding
- Intracranial neoplasm.
- Ischemic stroke within three months.
- Possible aortic dissection.
- Active bleeding or bleeding diathesis (excluding menses)

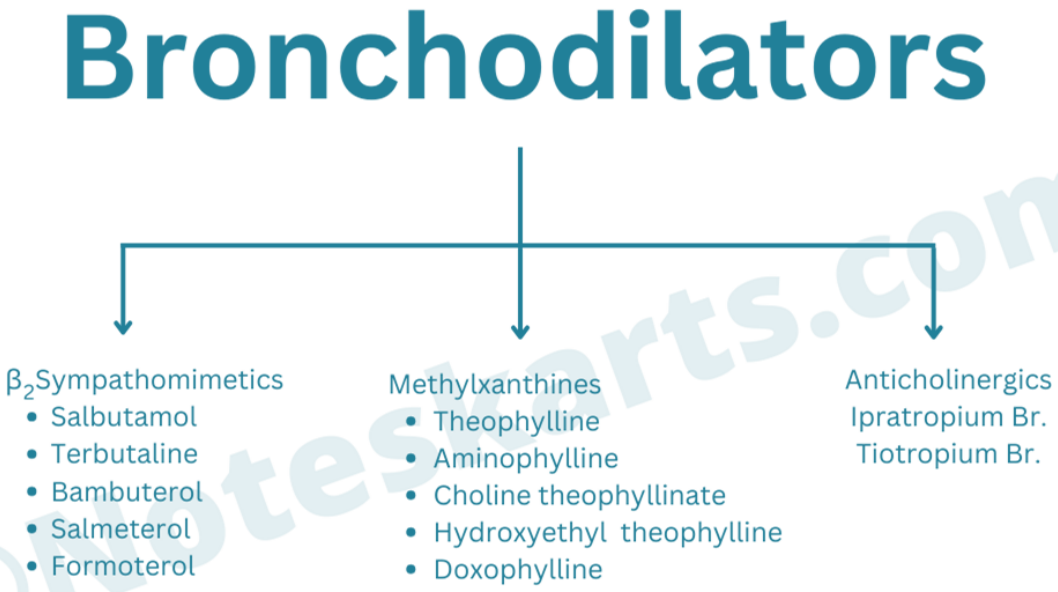
Definition, classification, pharmacological actions, dose, indications and contraindications of

- Bronchodilators
- Expectorants
- Anti-tussive agents
- Mucolytic agents

Bronchodilators:

- Bronchodilators are a type of medication that make breathing easier by relaxing the muscles in the lungs and widening the airways (bronchi).

Classification:



Salbutamol:

- It belongs to a class of medications known as short-acting beta-2 adrenergic agonist.
- Salbutamol works by stimulating the beta-2 adrenoceptors in your bronchial muscles.

Pharmacological actions:

- Salbutamol stimulate β2 adrenergic receptors which are predominant receptors in bronchial smooth muscle (β2-receptors are present in human heart in a concentration between 10% and 50%).
- Stimulation of β2 receptors leads to the activation of enzyme adenyl cyclase that form cyclic AMP (adenosine-mono-phosphate) from ATP (adenosine-tri-phosphate).

Dose:

- 2-4 mg oral
- 0.25-05 mg I.M./S.C.
- 100-200 µg by inhalation

Indications:

Salbutamol is indicated for

(i) the symptomatic relief and prevention of bronchospasm due to bronchial asthma, chronic bronchitis, reversible obstructive airway disease, and other chronic bronchopulmonary disorders in which bronchospasm is a complicating factor.
(ii) The acute prophylaxis against exercise-induced bronchospasm and other stimuli known to induce bronchospasm.
(iii) Salbutamol (albuterol) is a medication used to relax and open up your airways.
(iv) It is used to relieve wheezing, coughing, chest tightness and breathlessness.
(v) Salbutamol injection is also used for the management of uncomplicated premature labour between 22 and 37 weeks of pregnancy.

Contraindications:

- Feeling shaky
- Headache
- Muscle cramps
- Muscle tension
- Your heart beats too fast, too slow or irregularly (cardiac arrhythmia).

Expectorants

- Expectorants are the drugs that help in removing sputum from the respiratory tract either by increasing the fluidity (or reducing the viscosity) of sputum or increasing the volume of fluids that have to be expelled from the respiratory tract by coughing.
- **Examples of inorganic expectorants are ammonium chloride, potassium iodide, sodium iodide and related substances.**

Classification of expectorants is according to their mechanism of action

1. Sedative type
2. Stimulant type.

Sedative expectorants.

These are stomach irritant expectorants which are able to produce their effect through stimulation of gastric reflexes.

- **Examples of sedative expectorants :** Asipecac, senega, Indian squill, and compounds such as antimony potassium tartrate, ammonium chloride, sodium citrate, potassium iodide, etc.

Stimulant expectorants.

These are the expectorants which bring about a stimulation of the secretory cells of the respiratory tract directly or indirectly.

- **Example:** Eucalyptus, lemon, anise, and active constituents of oil like terpinebydrate, anethole.

Pharmacological Action

Expectorants reduce the viscosity of tenacious secretions by irritating the gastric vagal receptors that stimulate respiratory tract fluid, thus increasing the volume but decreasing the viscosity of respiratory tract secretions.

Indications:

- Expectorants also help to relieve chest congestion that occurs because of a cold, the flu, or allergies.
- Potassium iodide has been used to increase the water content of secretions and improve breathing in people with conditions such as asthma, chronic bronchitis, or emphysema.
- Expectorants aim to make coughing up mucus easier, they do not actually stop coughing.

Contraindications:

- A severe headache
- Confusion
- Excess salivation
- Fatigue
- Irregular heartbeat
- Numbness, tingling, pain or weakness in the hands or feet
- Gastrointestinal effects (such as acid reflux, diarrhea, nausea, vomiting, and stomach pain)

Anti-tussive agents

Cough is an essential protective reflex response to irritating stimuli in the respiratory tract.

It involves the sudden, usually involuntary, expulsion of air from the lungs.

Cough can prevent foreign bodies from entering the lungs or aid the removal of mucus and irritants from the lungs.

Classification of Antitussives

1. Opioids:

- Ex-Codeine, Ethylmorphine, Pholcodeine.

2. Nonopioids:
    - Ex-Noscapine, Dextromethorphan, Chlophedianol.
3. Antihistamines:
    - Ex-Chlorpheniramine, Diphenhydramine, Promethazine.
4. Peripherally acting:
    - Ex-Prenoxdiazine.
5. Adjuvant antitussives/ Bronchodilators:
    - Ex-Salbutamol, Terbutalin.

Note: Pharmacological actions, indications and contraindications Same As Bronchodilators

Mucolytics

- These are agents that reduce viscosity (liquefaction) of respiratory tract secretions without increasing their amount.
- Mucolytics are drugs used to manage mucus hypersecretion and its sequelae like recurrent infections in patients of COPD, cystic fibrosis, and bronchiectasis.
- They belong to a group of agents called mucoactive agents.

Classification of Mucolytics

1. **Bromhexine**
2. **Ambroxol** (It is metabolite of bromhexine and less gastric irritant).
3. **Acetylcysteine** (It could be given orally or by inhalation).

Pharmacological Action:

It reduces the viscosity of bronchial secretion by fragmenting its glycoproteins so mucus becomes less viscid and easily to expel.

Indications:

- Respiratory diseases e.g. bronchiectasis
- Post-operative and post-traumatic pulmonary - complications.
- Chronic sinusitis.

Contraindications:

- Fever.
- Runny nose.
- Sore throat.
- Drowsiness.
- Nausea.
- Vomiting.
- Diarrhea.
- Headache.

Chapter -8
Drugs Acting on the Gastro Intestinal Tract

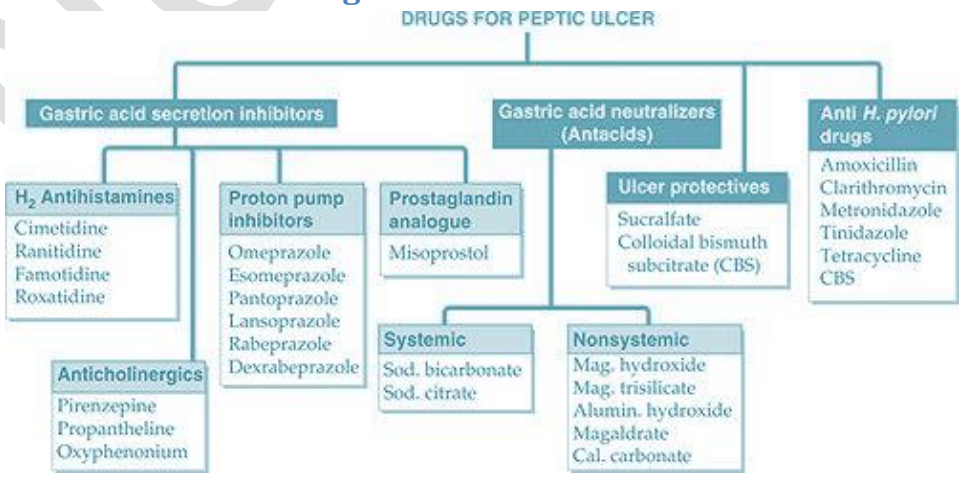
Drugs Acting on the Gastro Intestinal Tract
Definition, classification, pharmacological actions, dose, indications and contraindications of

- Anti-ulcer drugs
- Anti-emetics
- Laxatives and purgatives
- Anti-diarrheal drugs

Anti-ulcer drugs:

- Anti-ulcer drugs are medications that are used to treat ulcers in the stomach and small intestine.
- Anti-ulcer drugs, also known as acid-suppressing drugs or ulcer healing drugs, are medications that are used to treat and prevent the formation of stomach and duodenal ulcers.
- They work by reducing the amount of acid produced by the stomach or by promoting the healing of existing ulcers.
- Examples of anti-ulcer drugs include proton pump inhibitors (PPIs), H2 receptor antagonists, and mucosal protectants.
- These drugs are usually taken orally, and they can be prescribed by a doctor to help manage symptoms of ulcers and prevent recurrence of the ulcers.

Classification of Anti-ulcer drugs:



Omeprazole:

- Omeprazole is a proton pump inhibitor (PPI) medication used to reduce the amount of acid produced by the stomach.
- It is used to treat symptoms of Gastro Esophageal Reflux Disease (GERD), such as heartburn and acid indigestion, as well as to treat stomach and duodenal ulcers.

Pharmacological Action:

- Omeprazole works by blocking the action of the enzyme in the stomach that produces acid, called H+/K+-ATPase.
- This reduces the amount of acid in the stomach, which helps to alleviate symptoms and promote healing of ulcers.

Dose:

- Omeprazole is available in both over-the-counter and prescription forms and is typically taken once or twice daily before a meal.

Amoxicillin:

- Amoxicillin is an antibiotic medication in the penicillin class used to treat a variety of bacterial infections.

Pharmacological Action:

- It works by inhibiting the growth and replication of bacteria by interfering with the formation of their cell walls.

Uses:

- Amoxicillin is commonly used to treat respiratory tract infections such as bronchitis and pneumonia, skin infections such as cellulitis, urinary tract infections, and infections of the middle ear.
- It can also be used to prevent bacterial infections in certain individuals.

Dose:

- Amoxicillin is available in oral and injectable forms.
- It is usually taken every 8 hours, or 3 times a day, and should be taken with food to reduce stomach upset.
- The length of treatment depends on the type and severity of the infection, but it typically ranges from 5 to 14 days.

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Ranitidine—

- This nonimidazole (has a furan ring in place of imidazole ring) H2 blocker, has several desirable features compared to cimetidine. It is 5 times more potent than cimetidine.
- Dose— for ulcer healing 300 mg at bed time or 150 mg BD.

Indications for use of anti-ulcer drugs include:

- Peptic ulcer disease
- Gastroesophageal reflux disease (GERD)
- Zollinger-Ellison Syndrome
- Non-steroidal anti-inflammatory drug (NSAID) induced ulcers

Contraindications for anti-ulcer drugs include:

- Allergy to the specific medication
- Pregnancy and breastfeeding
- In combination with certain other medications, such as blood thinners
- Pre-existing conditions such as liver or kidney disease It is important to consult a healthcare professional before taking these medications to ensure they are appropriate for you and to discuss any potential risks or interactions with other medications you may be taking.

Anti-emetics

Anti-emetics are medications used to prevent or reduce nausea and vomiting.

They work by blocking the action of certain chemicals in the brain that trigger the sensation of nausea and vomiting.

Common types of anti-emetics include

- Serotonin receptor antagonists
- Dopamine receptor antagonists
- Antihistamines

These medications can be used to prevent nausea and vomiting caused by chemotherapy, radiation therapy, surgery, and other medical conditions.

They can be administered orally, intravenously, intramuscularly or rectally and may be used alone or in combination with other medications.

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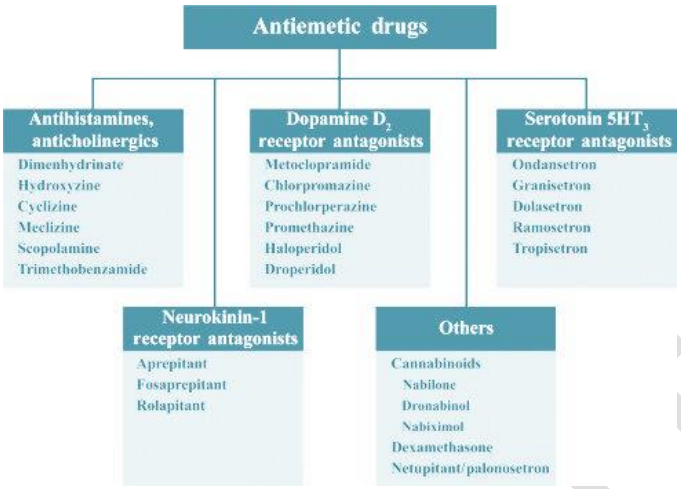
Classification of Anti-emetics



Pharmacological Action:

Anti-emetics work by targeting specific neurotransmitters and receptors in the brain and gut that are involved in the control of nausea and vomiting.

1. **Serotonin receptor antagonists (5-HT3 receptor antagonists):** These medications block the action of serotonin, a neurotransmitter that plays a key role in the control of emesis, on the 5-HT3 receptors in the brain and gut.
    - By blocking these receptors, these drugs prevent the activation of the vomiting center in the brain and reduce nausea. Examples include ondansetron, granisetron, dolasetron, and palonosetron.
2. **Dopamine receptor antagonists:** These medications block the action of dopamine, another neurotransmitter that is involved in the control of emesis, on the dopamine receptors in the brain.
    - They can be used to prevent nausea and vomiting caused by chemotherapy and surgery. Examples include metoclopramide, prochlorperazine, and haloperidol.
3. **Anti-histamines:** These medications block the action of histamine, a chemical involved in the control of emesis, on the H1 receptors in the brain.
    - They can be used to prevent nausea and vomiting caused by motion sickness and other causes. **Examples include meclizine, promethazine and Diphenhydramine.**

Metoclopramide—

- Metoclopramide is an effective antiemetic. Acting on the CTZ it blocks apomorphine induced vomiting. The gastrokinetic action may contribute to the antiemetic effect. However, it has no chlorpromazine (CPZ) like antipsychotic property, though it does share the extrapyramidal and prolactin secretion augmenting actions of CPZ

- It normally acts to delay gastric emptying when food is present in the stomach. It also appears to cause gastric dilatation and LES relaxation attending nausea and vomiting.

Dose—10 mg TDS oral (children 0.2 to 0.5 mg/kg).

Indications:

- Nonspecific nausea and vomiting.
- Chemotherapy-induced nausea and vomiting.
- Vertigo (e.g., vestibular neuritis, Ménière's disease)
- Motion sickness.
- Gastrointestinal motility disorder (e.g., due to diabetic gastroparesis)

Contraindication:

- Allergic reactions
- Gastrointestinal obstruction
- Seizure disorders
- Pregnancy and breastfeeding

Laxatives and purgatives:

Laxatives and purgatives are medications that are used to treat constipation and other bowel-related conditions.

- **Laxatives** are medications that help to stimulate bowel movements and promote the passage of stool.
- They work by various mechanisms such as increasing the bulk of the stool, lubricating the stool to make it easier to pass, or by stimulating the muscles of the intestinal wall to contract and push the stool out.
- **Purgatives**, also known as cathartics, are medications that are used to cause a bowel movement, usually within a short time frame.
- They are usually used in cases of severe constipation or when a bowel movement is needed urgently. Some examples of purgatives are Bisacodyl, Senna, castor oil, and magnesium citrate.

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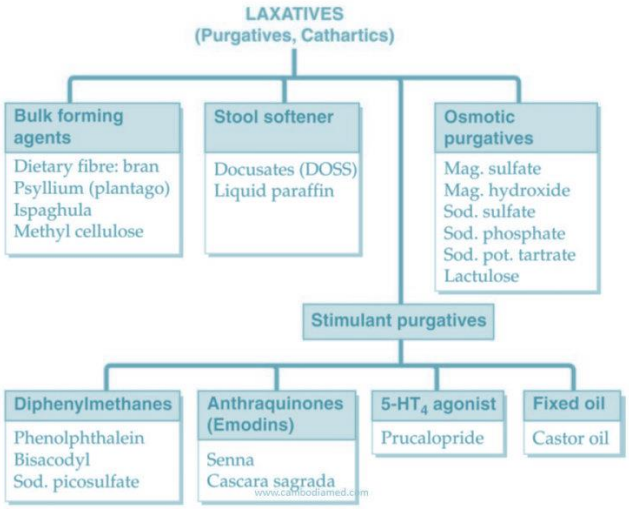
Classification of Laxatives and purgatives:



Pharmacological actions:

The pharmacological actions of laxatives and purgatives vary depending on the type of medication.

- **Bulk-forming laxatives:** These medications work by absorbing water and increasing the bulk of the stool, making it easier to pass. Examples include psyllium, methylcellulose, and polycarbophil.
- **Lubricant laxatives:** These medications work by coating the stool with a slippery substance, making it easier to pass. Examples include mineral oil and glycerin.
- **Stool softeners:** These medications work by increasing the water content of the stool, making it softer and easier to pass. Examples include docusate sodium and docusate calcium.
- **Stimulant laxatives:** These medications work by stimulating the muscles of the intestinal wall to contract and push the stool out. Examples include bisacodyl, senna, and cascara.
- **Osmotic laxatives:** These medications work by drawing water into the colon and increasing the volume of the stool, making it easier to pass. Examples include lactulose, polyethylene glycol, and magnesium citrate.
- **Purgatives:** These medications work by rapidly increasing the fluid content of the colon, causing strong contractions of the colon and rectum muscles, and promoting the passage of stool. Examples include senna, castor oil, and magnesium citrate.

Indications:

- Constipation
- Preoperative bowel preparation
- Fecal impaction
- Hemorrhoids
- Anal fissures

Contraindications:

Laxatives and purgatives are generally considered safe medications, but there are certain situations in which they should not be used. Some of the common contraindications of laxatives and purgatives include:

- Abdominal pain
- Nausea, and vomiting
- Rectal bleeding
- Gastrointestinal obstruction
- Diarrhea
- Inflammatory bowel disease

Anti-diarrheal drugs:

- Anti-diarrheal drugs are medications that are used to treat diarrhea, which is defined as an increase in the frequency, volume, or fluid content of stools.
- They work by slowing down the movement of the muscles in the gut, which helps to reduce the frequency and urgency of bowel movements.
- They also can reduce the amount of fluid in the stool, making the stools more solid.
- They may also work by adsorbing toxins or bacteria in the gut, by inhibiting the secretion of fluid in the gut or by altering gut motility.

Classification of Anti-diarrheal drugs

- **Non antimicrobial anti-diahrrhoeals**
    I. Antimotility agents: diphenoxylate, loperamide, codeine.
    II. Anticholinergic agents: atropine, scopolamine
- **Specific anti-infective agents**
    I. Antimicrobials: co-trimaxozole, norfloxacin, doxycycline, erythromycin, metronidazole
    II. Antisecretary agents: sulfasalazine, mesalazine

Metronidazole—it is an antiprotozoal and antibiotic medication commonly used during the diarrhea cause by the protozoan. It is used either alone or with other antibiotics to treat pelvic inflammatory disease, endocarditis, and bacterial vaginosis. It is effective for dracunculiasis, giardiasis, trichomoniasois and amebiasis.

Dose— 400 mg BD or 7.5 mg/ kg.

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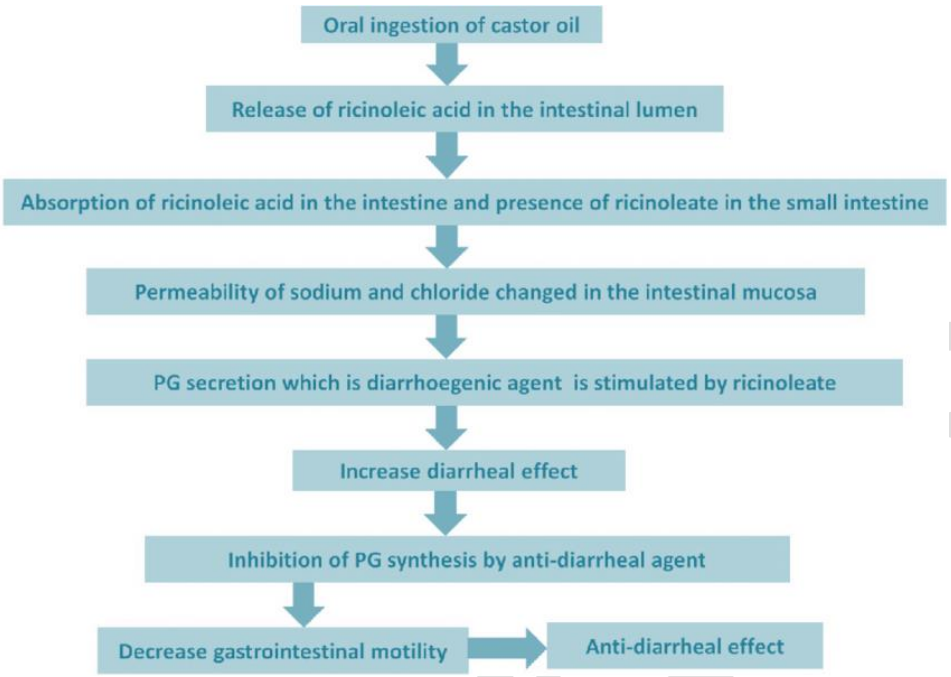
Pharmacological action of Antidiarrheal drugs:



Indication of Antidiarrheal drugs:

Some of the common indications for the use of anti-diarrheal drugs include:

- Acute/chronic diarrhea
- Pre-radiographic procedure
- Traveler's diarrhea

Contraindication of Antidiarrheal drugs:

- Gastrointestinal obstruction
- Inflammatory bowel disease
- Allergic reactions
- Renal and hepatic impairment
- Fecal incontinence

Chapter-9 | Pharmacology

Drugs Acting on the Kidney

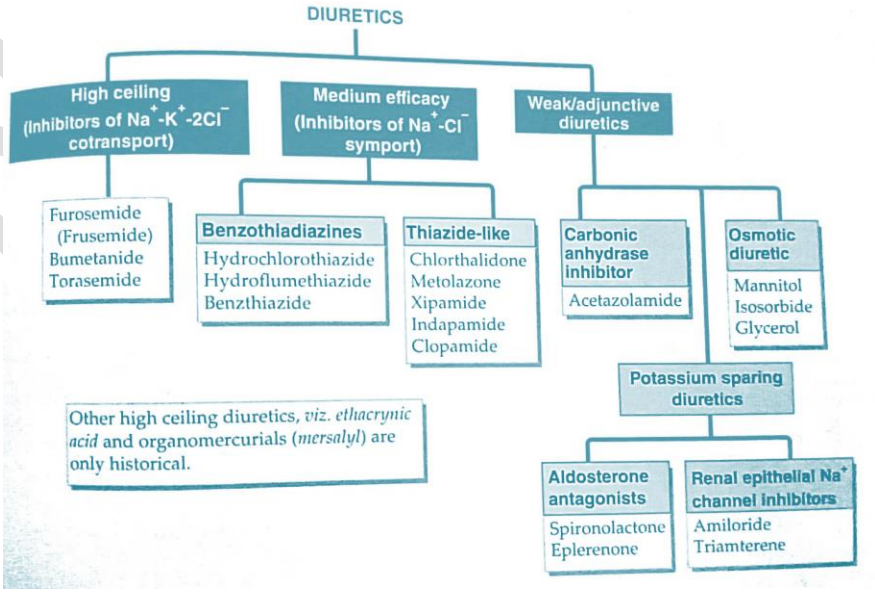
Drugs Acting on the Kidney Definition, classification, pharmacological actions, dose, indications, and contraindications of

- **Diuretics**
- **Anti-Diuretics**

Diuretic:

- Diuretics are drugs which cause a net loss of Na+ and water in urine.
- Diabetics is given regularly balance is soon restore by compost station hemostatic mechanism of the body albeit with a certain in extracellular fluid valume.
- Diuretics are the most prescribed drugs.

Classification of Diuretic:



Pharmacological actions Diuretic:

- The act by diminishing sodium reabsorption at different sites in the nephron, thereby increasing urinary sodium and water losses.
- Diuretics drugs increase urine output by the kidney.

Furosemide

- Furosemide is a loop diabetic medication used to treat fluid build up due to the heart failure kidney disease liver scarring.
- It can be taken by injection into vein or by mouth.

Dose: 20-80mg once daily in the morning.

In renal effect 200 mg hourly has been given by I.V./I.V. route.

Indications:

- Volume overload and edema
- Congestive heart failure exacerbation,
- Liver failure
- Renal failure
- Nephrotic syndrome.

Contraindications

- Use of a higher than the recommended dose of furosemide or a fast infusion rate of the drug,
- Hypoalbuminemia comorbid illnesses.
- The concomitant use of ethacrynic acid, aminoglycosides, or other ototoxic drugs.
- Patients with underlying severe renal impairment.

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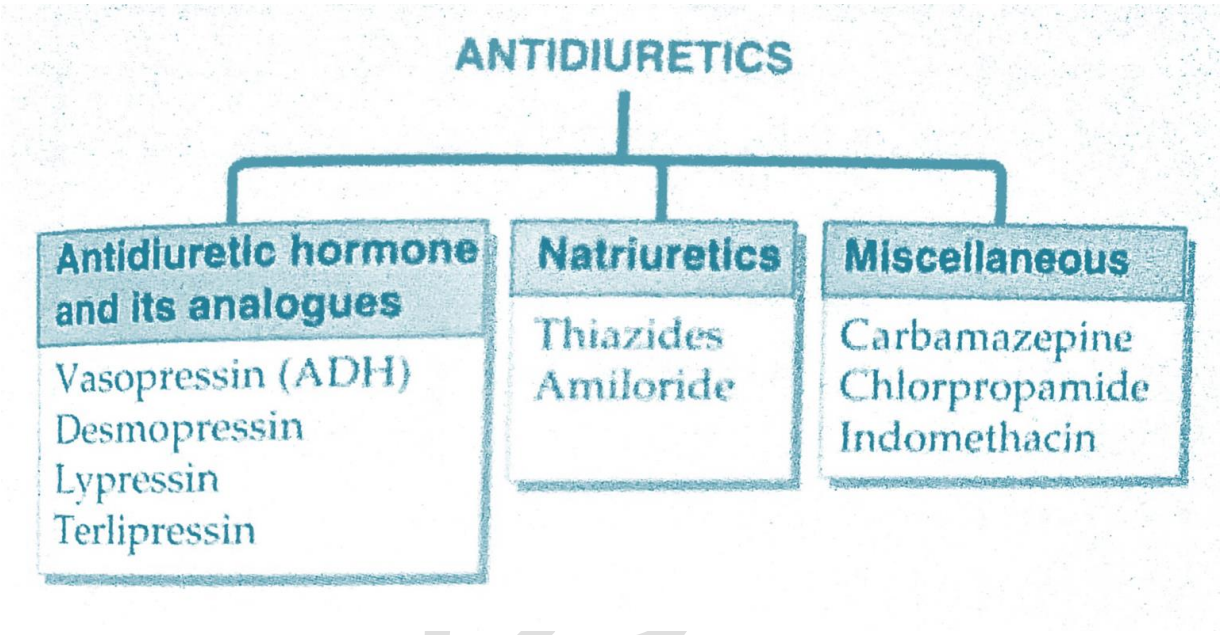
Antidiuretics drugs

- Antidiuretics inhibit water excretion without affecting salt extraction.
- The drug that reduces urine volume particularly in diabetes insipidus (DI) which is their indication.

Classification of Antidiuretics drugs:



Desmopressin:

- Desmopressin is also used to control excessive thirst and the passage of an abnormally large amount of urine that may occur after a head injury or after certain types of surgery.
- Desmopressin is a man-made form of vasopressin and is used to replace a low level of vasopressin.

Pharmacological Action:

- Desmopressin Upon binding of desmopressin to V2 receptors in the basolateral membrane of the cells of the distal tubule and collecting ducts of the nephron, adenylyl cyclase is stimulated.
- The resulting intracellular cascades in the collecting duct lead to increased rate of insertion of water channels, called aquaporins, into the lumenal membrane and enhanced the permeability of the membrane to water.

Dose:

- Adults 10-40 µg/day in 2-3 divided doses.
- Children (for bed wetting) 5-10 µg at bed time.

- Oral0.1-0.2 mg TDS,
- Parenteral (S.C. or I.V.) 2-4 µg/day in 2-3 divided doses.

Indications:

- Treatment of polyuric
- Primary nocturnal enuresis,
- Nocturia,
- Diabetes insipidus.
- Hemophilia
- Von Willebrand's Disease (Type I)

Contraindications:

- Renal Disease & Cardiac insufficiency.
- Hyponatremia
- Contraindicated in individuals with known hypersensitivity to desmopressin acetate or to any of the components.

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Chapter-10
Hormones and Hormone Antagonists

Hormones and Hormone Antagonists Physiological and pathological role and clinical uses of

- Thyroid hormones
- Anti-thyroid drugs
- Parathormone
- Calcitonin
- Vitamin D
- Insulin
- Oral hypoglycemic agents
- Estrogen
- Progesterone
- Oxytocin
- Corticosteroids

Hormones:

- Hormones are chemical messengers that coordinate different functions in your body. Several glands, organs and tissues make and release hormones, many of which make up your endocrine system.
- Hormones are produced by glands in the endocrine system that regulate various bodily functions.
- They are released into the bloodstream and travel to target organs or tissues where they exert their effects by binding to specific receptors.
- Scientists have identified over 50 hormones in the human body so far.

Hormone antagonists:

Hormone antagonists are compounds that bind to hormone receptors and block their activation by endogenous hormones.

Physiological Role of Hormone Antagonists:

- Hormone antagonists play a role in regulating the balance of hormones in the body.
- They can also act as feedback inhibitors to prevent excessive hormone production.

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Pathological Role of Hormone Antagonists:

- Hormone antagonists can cause hormonal imbalances leading to various diseases, such as infertility, osteoporosis, and cancer.
- Certain hormonal antagonists can also be used to treat these diseases by blocking the action of the hormones involved in their development.

Thyroid hormones:

- Thyroid hormones are produced by the thyroid gland and play a crucial role in regulating metabolism, growth, and development.
- Thyroid is a small, butterfly-shaped gland located at the front of your neck under your skin.
- They can be used clinically to treat conditions such as hypothyroidism, thyroid cancer, and goiter.

Thyroid releases the following hormones:

- Thyroxine (T4).
- Triiodothyronine (T3).
- Reverse triiodothyronine (RT3).
- Calcitonin.

Physiological Roles:

- Thyroid hormones play a vital role in regulating metabolism, energy expenditure, and body temperature.
- They also influence heart rate, respiratory rate, and other vital functions.
- They play a role in growth and development, particularly in the development of the brain and nervous system.

Pathological Roles:

- Hypothyroidism occurs when the thyroid gland doesn't produce enough hormones. This can result in a variety of symptoms, including fatigue, weight gain, and sensitivity to cold.
- Hyperthyroidism occurs when the thyroid gland produces too much hormone. This can result in symptoms such as weight loss, rapid heartbeat, and sensitivity to heat.
- Thyroid disorders can be caused by a variety of factors, including autoimmune disorders, iodine deficiency, and certain medications.

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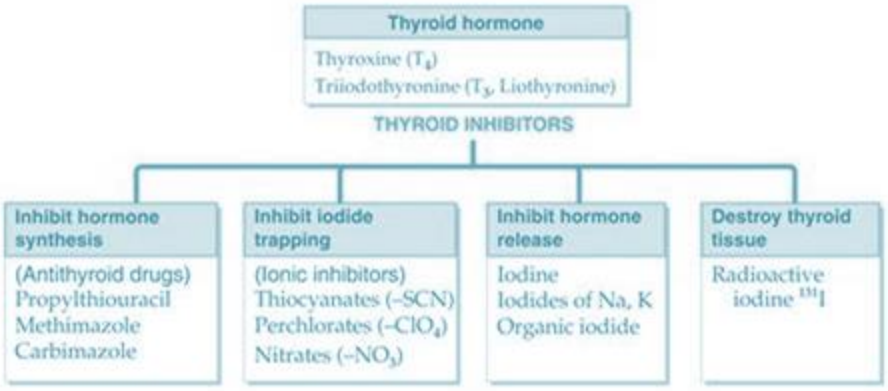
Clinical Uses of Thyroid Hormones:

- Thyroid hormone replacement therapy is used to treat hypothyroidism, a condition where the thyroid gland is not producing enough hormones.
- Thyroid hormones can also be used to treat thyroid cancer, by suppressing the production of thyroid-stimulating hormone.
- Thyroid hormones are also used to treat goiter, a condition where the thyroid gland enlarges, by reducing the size of the gland.
- Hyperthyroidism can be treated with medications that reduce thyroid hormone production or block the effects of thyroid hormones.
- Thyroid function tests can be used to diagnose thyroid disorders.
- Radioactive iodine therapy can be used to treat hyperthyroidism by destroying the thyroid gland.

Anti-thyroid drugs:

Anti-thyroid drugs are medications used to treat hyperthyroidism, a condition in which the thyroid gland produces too much thyroid hormone. These drugs work by blocking the production of thyroid hormone in the thyroid gland.

Classification of Anti-thyroid Drugs:



The two main types of anti-thyroid drugs are:

1. Thioamides: Thioamides, also known as thioureas, are the most commonly used anti-thyroid drugs. They work by blocking the enzyme responsible for making thyroid hormone in the thyroid gland. The two thioamides used in the United States are methimazole and propylthiouracil (PTU).

2. Iodine: Iodine can be used to treat hyperthyroidism, especially if the condition is caused by a condition called thyroiditis. Iodine works by reducing the activity of the thyroid gland, thereby reducing the production of thyroid hormone.

Parathormone:

Parathormone (PTH) is a hormone produced by the parathyroid glands that plays a crucial role in maintaining calcium and phosphate levels in the body.

Physiological role:

- PTH increases blood calcium levels by increasing bone resorption, which releases calcium into the bloodstream. It also decreases excretion of calcium by the kidneys and increases absorption of calcium from the intestines.
- PTH stimulates the production of active vitamin D, which promotes intestinal absorption of calcium and phosphate.
- PTH also regulates phosphate levels in the body by decreasing reabsorption of phosphate by the kidneys.

Pathological role:

- Excessive secretion of PTH can lead to hyperparathyroidism, a condition where blood calcium levels are elevated, which can cause symptoms such as weakness, bone pain, and kidney stones.
- Inadequate secretion of PTH can lead to hypoparathyroidism, a condition where blood calcium levels are low, which can cause symptoms such as muscle cramps and seizures.

Clinical uses:

- PTH can be used as a diagnostic tool to differentiate between primary and secondary hyperparathyroidism.
- PTH analogs, such as teriparatide, can be used to treat osteoporosis by increasing bone formation.
- PTH can be used in the treatment of hypoparathyroidism to increase blood calcium levels.

Calcitonin:

Calcitonin is a hormone produced by the C-cells of the thyroid gland. It plays important physiological and pathological roles in the body, and has several clinical uses.

Physiological Role:

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- Calcitonin helps to regulate calcium and phosphate homeostasis in the body.
- It decreases the concentration of calcium and phosphate in the blood by inhibiting the activity of osteoclasts, which are cells that break down bone tissue and release calcium and phosphate into the blood.
- Calcitonin also increases the excretion of calcium and phosphate in the urine.

Pathological Role:

- Elevated levels of calcitonin can indicate the presence of thyroid cancer, specifically medullary thyroid cancer, as these cancer cells produce excess amounts of the hormone.
- In rare cases, calcitonin can cause hypocalcemia (low levels of calcium in the blood), which can lead to muscle weakness, spasms, and convulsions.

Clinical Uses:

- Calcitonin is used as a medication to treat osteoporosis, a condition in which bones become weak and brittle. It works by inhibiting bone resorption and promoting bone formation.
- It is also used to treat hypercalcemia (high levels of calcium in the blood) associated with malignancy, as it can help to lower blood calcium levels.
- Calcitonin can also be used to relieve pain associated with osteoporosis or vertebral fractures.

Vitamin D:

Vitamin D is a fat-soluble vitamin that plays an important role in the body's calcium and phosphate homeostasis.

Physiological Role:

- Vitamin D helps the body absorb and utilize calcium and phosphorus, which are essential for building and maintaining strong bones and teeth.
- It also regulates the immune system and promotes the growth and differentiation of cells, including those in the skin and bone.
- Vitamin D may also have a role in reducing the risk of certain cancers, autoimmune diseases, and cardiovascular disease.

Pathological Role:

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- Vitamin D deficiency can lead to rickets in children, which is a condition characterized by weak and deformed bones. In adults, a deficiency can lead to osteomalacia, which causes weak bones and muscle weakness.
- Low levels of vitamin D have also been linked to an increased risk of falls, fractures, and other musculoskeletal disorders.

Clinical Uses:

- Vitamin D supplements are often prescribed to individuals who are at risk of deficiency, such as those with limited sun exposure, older adults, and people with certain medical conditions or medications that interfere with vitamin D absorption.
- Vitamin D supplements may also be used to treat osteoporosis, a condition characterized by weakened bones.
- Vitamin D may have a role in the prevention and treatment of other conditions, such as multiple sclerosis, depression, and chronic pain, but more research is needed to fully understand its potential benefits.

Insulin:

Insulin is a hormone produced by the beta cells of the pancreas that plays a crucial role in regulating glucose metabolism in the body.

Physiological role:

- Insulin helps to regulate blood glucose levels by promoting the uptake and storage of glucose in the liver, muscle, and adipose tissue.
- It promotes the synthesis of glycogen in the liver and muscle, and inhibits the breakdown of glycogen in these tissues.
- Insulin also enhances the uptake of amino acids by the muscle, which promotes protein synthesis and tissue growth.
- Additionally, insulin inhibits lipolysis in adipose tissue, which reduces the release of free fatty acids into the bloodstream.

Pathological role:

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- In type 1 diabetes, the beta cells in the pancreas are destroyed, leading to a lack of insulin production and uncontrolled hyperglycemia.
- In type 2 diabetes, the body becomes resistant to the effects of insulin, leading to elevated blood glucose levels.
- Other conditions such as insulinoma (a rare tumor of the pancreas that secretes excess insulin) and insulin resistance syndromes can also result in abnormal insulin secretion or function.

Clinical uses:

- Insulin is a mainstay treatment for type 1 diabetes and may also be used in certain cases of type 2 diabetes when other medications have failed.
- It may also be used in gestational diabetes and other forms of diabetes that occur during pregnancy.
- In some cases, insulin therapy may be used in critical care settings to manage hyperglycemia and maintain normal glucose levels.
- Insulin may also be used off-label for bodybuilding and athletic performance enhancement, although this practice is not recommended and can be dangerous.

Oral hypoglycemic agents:

Oral hypoglycemic agents (OHAs) are medications used to treat type 2 diabetes by lowering blood glucose levels. These agents work by increasing insulin sensitivity, increasing insulin secretion, or reducing glucose production in the liver.

Physiological role:

- OHAs work by improving the body's response to insulin, which is a hormone that regulates blood sugar levels.
- OHAs can reduce insulin resistance and increase insulin sensitivity, which helps the body use glucose more effectively and lower blood sugar levels.
- OHAs can also reduce glucose production in the liver, which can help control fasting blood sugar levels.

Pathological role:

- OHAs are used to treat type 2 diabetes, which is a chronic condition characterized by high blood sugar levels due to insulin resistance and/or insufficient insulin secretion.

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- Type 2 diabetes can lead to complications such as cardiovascular disease, kidney disease, nerve damage, and vision loss if not properly managed.

Clinical uses:

- OHAs are used in conjunction with lifestyle modifications such as diet and exercise to manage type 2 diabetes.
- Different types of OHAs are available, including biguanides, sulfonylureas, meglitinides, thiazolidinediones, DPP-4 inhibitors, GLP-1 receptor agonists, and SGLT-2 inhibitors.
- The choice of OHA depends on various factors such as the patient's age, health status, kidney function, and other medications they may be taking.
- OHAs are typically used as first-line therapy for most patients with type 2 diabetes, and insulin therapy may be added later if blood sugar levels are not adequately controlled.
- OHAs can also be used to manage prediabetes and gestational diabetes, which are conditions characterized by elevated blood sugar levels but not as high as in type 2 diabetes.

Estrogen:

Estrogen is a hormone produced mainly by the ovaries in women and to a lesser extent by the testes in men. Estrogen plays several physiological roles in the body, and it also has several pathological effects when its levels are not balanced.

Physiological roles of estrogen:

- Development and maintenance of female reproductive organs: Estrogen plays a vital role in the development of female reproductive organs such as the uterus, fallopian tubes, and vagina. It also helps in maintaining the function and health of these organs.
- Development of secondary sexual characteristics: Estrogen is responsible for the development of secondary sexual characteristics in females such as the growth of breasts, distribution of body fat, and changes in body hair.
- Bone health: Estrogen helps maintain bone density and prevent osteoporosis in both men and women.
- Cardiovascular health: Estrogen has a protective effect on the cardiovascular system by reducing the risk of heart disease.
- Brain function: Estrogen has an important role in cognitive function, memory, and mood regulation.

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Pathological effects of estrogen:

1. Breast cancer: High levels of estrogen can promote the growth of breast cancer cells.
2. Endometrial cancer: Estrogen can increase the risk of endometrial cancer if the levels are not balanced.
3. Blood clots: Estrogen can increase the risk of blood clots, which can lead to deep vein thrombosis or pulmonary embolism.
4. Ovarian cancer: Estrogen can increase the risk of ovarian cancer.

Clinical uses of estrogen:

- Hormone replacement therapy: Estrogen is used in hormone replacement therapy (HRT) to alleviate symptoms of menopause such as hot flashes, vaginal dryness, and mood swings.
- Contraception: Estrogen is used in combination with progestin as an oral contraceptive.
- Osteoporosis treatment: Estrogen is sometimes used to treat osteoporosis in postmenopausal women.
- Gender-affirming hormone therapy: Estrogen is used in gender-affirming hormone therapy for transgender women to develop feminine characteristics.

Progesterone:

Progesterone is a steroid hormone that plays a significant role in the menstrual cycle, pregnancy, and overall reproductive health.

Physiological Role:

1. Menstrual Cycle: Progesterone prepares the uterus for implantation and maintains the lining of the uterus during the second half of the menstrual cycle.
2. Pregnancy: Progesterone plays a crucial role in maintaining a healthy pregnancy by thickening the uterus lining, preventing the uterus from contracting and helping the body prepare for breastfeeding.
3. Breast Development: Progesterone works with estrogen to promote breast development during puberty and pregnancy.
4. Bone Health: Progesterone is essential for maintaining bone health and reducing the risk of osteoporosis.

Pathological Role:

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1. Hormonal Imbalance: A lack of progesterone can cause menstrual irregularities and infertility in women.
2. Miscarriage: Low progesterone levels in early pregnancy can increase the risk of miscarriage.

Clinical Uses:

1. Hormone Replacement Therapy (HRT): Progesterone is used in combination with estrogen in HRT to manage menopausal symptoms, such as hot flashes, vaginal dryness, and mood swings.
2. Infertility Treatment: Progesterone supplements are used to support the early stages of pregnancy in women who have difficulty conceiving.
3. Premenstrual Syndrome (PMS): Progesterone supplements can alleviate symptoms of PMS, such as bloating, breast tenderness, and mood swings.
4. Endometriosis: Progesterone therapy can help to manage the symptoms of endometriosis, such as pelvic pain and heavy periods.
5. Menstrual Disorders: Progesterone is sometimes used to treat menstrual disorders, such as heavy or irregular periods.

Oxytocin:

Oxytocin is a hormone produced by the hypothalamus and released from the posterior pituitary gland. It plays a crucial role in a wide range of physiological processes, including childbirth, lactation, and social bonding.

Physiological Role:

1. Labor and Delivery: Oxytocin stimulates uterine contractions, facilitating labor and delivery. It also plays a role in the dilation of the cervix during childbirth.
2. Lactation: Oxytocin helps stimulate the let-down reflex, which enables milk to be released from the mammary glands during breastfeeding.
3. Social Bonding: Oxytocin has been linked to social bonding, particularly between mother and child, and between romantic partners. It promotes trust, empathy, and affection, which is why it is often referred to as the "love hormone."

Pathological Role:

1. Autism: Research suggests that individuals with autism have lower levels of oxytocin, which may contribute to social difficulties and a lack of emotional connection with others.

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2. Anxiety and Depression: Oxytocin has been shown to have anxiolytic (anti-anxiety) and antidepressant effects in animal models and human studies.

3. Eating Disorders: There is some evidence that oxytocin may play a role in the regulation of food intake and body weight, and its use has been explored as a potential treatment for anorexia and bulimia.

Clinical Uses:

1. Induction of Labor: Oxytocin is commonly used to induce labor in women who have gone past their due dates or have medical conditions that require early delivery.

2. Postpartum Hemorrhage: Oxytocin is also used to prevent and treat postpartum hemorrhage by promoting uterine contractions.

3. Breastfeeding: Oxytocin nasal spray has been used to improve lactation and milk ejection in breastfeeding mothers.

4. Autism: Research is ongoing to explore the potential use of oxytocin as a treatment for social and communication difficulties in individuals with autism.

5. Anxiety and Depression: Oxytocin is being investigated as a potential treatment for anxiety and depression, particularly in individuals who do not respond well to traditional medications.

Corticosteroids:

Corticosteroids are a class of hormones produced naturally by the adrenal cortex, which play a crucial role in maintaining the normal functioning of the body. They are also available in synthetic form for therapeutic use.

Physiological roles:

- Corticosteroids help regulate the body's metabolism of carbohydrates, fats, and proteins.
- They regulate the body's response to stress, by increasing blood sugar levels, blood pressure, and suppressing the immune response.
- They also play a role in maintaining the balance of salt and water in the body.

Pathological roles:

- Inflammatory disorders such as rheumatoid arthritis, asthma, and other autoimmune disorders can cause inflammation, swelling, and pain. Corticosteroids can help to suppress the immune response and reduce inflammation.

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- Allergic reactions can also cause inflammation, and corticosteroids can help to reduce symptoms such as itching, swelling, and hives.
- Corticosteroids can also be used to treat certain types of cancer, by slowing down the growth of cancer cells.

Clinical uses:

- Corticosteroids are commonly used to treat inflammation and pain associated with rheumatoid arthritis, lupus, and other autoimmune disorders.
- They are also used to treat severe allergic reactions, such as anaphylaxis, and to reduce swelling and inflammation associated with asthma and other respiratory conditions.
- Corticosteroids can be used to treat skin conditions such as eczema and psoriasis, and to reduce inflammation and pain associated with certain types of cancer.

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Chapter-11 | Pharmacology | Autacoids

Autacoids

- Physiological role of Histamine, 5 HT and Prostaglandins
- Classification, clinical uses and adverse effects of antihistamines and 5 HT antagonists

Autacoids:

- Autacoids are substances produced by the body that have local effects and can act as regulatory or mediatory agents.
- They are released from cells into the extracellular fluid and are involved in various physiological and pathological processes.
- It also known as Local Hormone.

There are three main types of autacoids:

- Prostaglandins: Hormone-like compounds that play a role in inflammation, pain, and regulation of blood flow.
- Leukotrienes: Potent pro-inflammatory mediators that play a role in allergic reactions and asthma.
- Histamine: A neurotransmitter involved in the regulation of gastric acid secretion, bronchoconstriction, and allergic reactions.

In summary, autacoids play an important role in various physiological processes and have significant effects on various tissues in the body. Understanding their actions and regulation is crucial for developing effective therapies for various conditions.

Histamine –

- A **chemical found in some of the body's cells** - causes many of the symptoms of allergies, such as a runny nose or sneezing. When a person is allergic to a particular substance, such as a food or dust, the immune system mistakenly believes that this usually harmless substance is actually harmful to the body.

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Physiological role of Histamine:

Histamine is a neurotransmitter that plays a critical role in many physiological processes in the body. Some of the key physiological functions of histamine include:

1. **Gastric Acid Secretion:** Histamine acts on the parietal cells in the stomach to stimulate the release of gastric acid, which is necessary for the digestion of food.
2. **Bronchoconstriction:** Histamine can cause the bronchial smooth muscles to contract, leading to bronchoconstriction. This is a key mechanism in asthma and other respiratory conditions.
3. **Allergic Reactions:** Histamine is released by mast cells in response to allergens and is a key mediator in the development of allergic symptoms such as itching, redness, and swelling.
4. **Vasodilation:** Histamine can cause the blood vessels to dilate, increasing blood flow and promoting tissue perfusion.
5. **Wakefulness and Alertness:** Histamine is involved in the regulation of wakefulness and alertness, and may play a role in attention and memory.

Overall, histamine plays a vital role in regulating many physiological processes and is involved in the body's response to a variety of stimuli. However, an overproduction or excessive response of histamine can lead to various conditions such as allergies, asthma, and anaphylaxis.

Antihistamines:

- Antihistamines are drugs that block the effects of histamine, a chemical released in the body during an allergic reaction.
- They are used to treat symptoms such as itching, runny nose, watery eyes, and sneezing caused by allergies, hay fever, and the common cold. Some common examples of antihistamines include diphenhydramine (Benadryl), loratadine (Claritin), and cetirizine (Zyrtec).
- Antihistamines are available over-the-counter and by prescription and can cause drowsiness in some people.

Classification:

- Amine derived: Histamine (amino acid: Histidine), Serotonin (Tryptophan)
- Peptide derived: Angiotensin, Bradykinin
- Lipid derived: Prostaglandins, Leukotrienes, Interleukins, Platelet Activating Factor, etc.

Clinical uses of antihistamines

Antihistamines are primarily used for the treatment of allergies and allergic symptoms, including:

- **Hay fever:** relief of symptoms such as sneezing, runny nose, and itchy eyes
- **Hives:** relief of skin itching and redness
- **Allergic conjunctivitis:** relief of eye symptoms such as redness, itching, and tearing
- **Allergic rhinitis:** relief of nasal symptoms such as stuffy nose and sneezing

- **Anaphylaxis:** emergency treatment of severe allergic reactions
- **Nausea and vomiting** caused by motion sickness
- **Insomnia:** some antihistamines have sedative effects and are used as sleep aids

Adverse Effect:

- Drowsiness
- Dry mouth
- Blurred vision
- Constipation
- Urinary retention
- Confusion and dizziness
- Headache

5-HT (5-hydroxytryptamine) antagonists:

- 5-HT (5-hydroxytryptamine) antagonists, also known as serotonin receptor antagonists, are a group of drugs that block the actions of the neurotransmitter serotonin.
- It is also belongs to an autacoids which release in our body mainly found GIT, platelets and CNS.
- It is derived from an amino acid and

They are used for a variety of medical conditions, including:

1. Migraines: 5-HT antagonists are used to prevent and treat migraines.
2. Depression: 5-HT antagonists are sometimes used as adjunctive treatment for depression, particularly for patients who do not respond well to other antidepressants.
3. Anxiety disorders: 5-HT antagonists are used to treat anxiety disorders, including social anxiety disorder and obsessive-compulsive disorder.
4. Nausea and vomiting: 5-HT antagonists are used to prevent and treat nausea and vomiting caused by various conditions, including chemotherapy, surgery, and radiation therapy.
5. Irritable bowel syndrome (IBS): 5-HT antagonists are used to treat symptoms of IBS, including abdominal pain and diarrhea.

Physiological role of 5 HT:

5-Hydroxytryptamine (5-HT), also known as serotonin, is a neurotransmitter that plays a key role in many physiological processes in the body. Some of the key physiological functions of 5-HT include:

1. Mood regulation: Serotonin is involved in regulating mood, and low levels of serotonin are associated with depression.
2. Appetite regulation: Serotonin plays a role in regulating appetite and is involved in the regulation of food intake.
3. Sleep regulation: Serotonin is involved in the regulation of sleep, with higher levels of serotonin promoting sleep and lower levels promoting wakefulness.
4. Nociception: Serotonin is involved in the perception of pain and is thought to play a role in the management of chronic pain.
5. Cardiovascular regulation: Serotonin has a role in regulating blood flow and is involved in the regulation of blood pressure.
6. Sexual behavior: Serotonin is involved in regulating sexual behavior, with higher levels of serotonin leading to decreased sexual desire and lower levels leading to increased sexual desire.

Overall, 5-HT plays a critical role in regulating various physiological processes and is involved in the regulation of mood, appetite, sleep, pain, cardiovascular function, and sexual behavior. An imbalance of serotonin levels can lead to various conditions, including depression, anxiety, and migraine headaches.

Adverse effects associated with 5-HT antagonists can include:

1. Nausea and vomiting
2. Dizziness and drowsiness
3. Headache
4. Sexual dysfunction
5. Dry mouth
6. Constipation

Prostaglandins

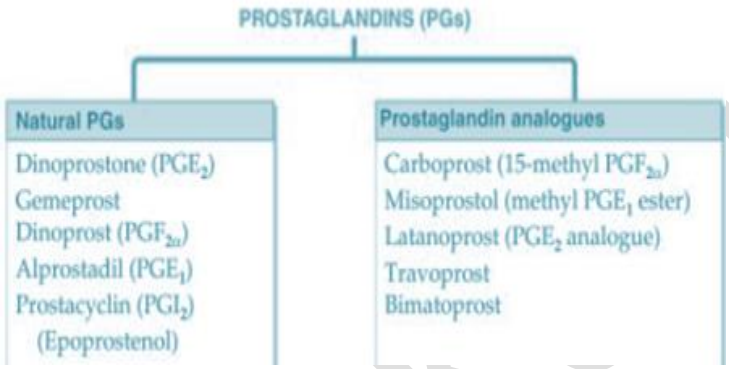
- Prostaglandins are a group of naturally occurring lipids that play important roles in various physiological processes.
- They are derived from the essential fatty acid arachidonic acid and are produced by many tissues in the body, including the lining of the stomach, blood vessels, and reproductive tract.

Some of the main functions of prostaglandins include:

1. Regulating blood flow and blood pressure

2. Controlling the contraction and relaxation of smooth muscle in the digestive tract and reproductive system
3. Regulating the production of mucus and bicarbonate in the gastrointestinal tract
4. Mediating pain and inflammation
5. Regulating the body's response to injury and infection

Classification Of Prostaglandins:



Physiological role of Prostaglandins:

Prostaglandins are hormone-like substances that are produced by the body and have local effects on various tissues. Some of the key physiological functions of prostaglandins include:

1. Pain and Inflammation: Prostaglandins play a crucial role in the regulation of pain and inflammation. They are involved in the production of pain and the development of inflammation in response to injury or infection.
2. Regulation of Blood Flow: Prostaglandins are involved in regulating blood flow, particularly in the blood vessels of the kidney and heart. They help to regulate blood pressure and prevent blood clots from forming.
3. Protection of the Stomach: Prostaglandins play a role in protecting the lining of the stomach from damage caused by stomach acid and other irritants.
4. Regulation of Labor: Prostaglandins are involved in the regulation of labor and delivery in pregnancy, causing the uterus to contract and helping to initiate labor.
5. Fertility: Prostaglandins are involved in the regulation of fertility and are necessary for the release of eggs from the ovaries and for the preparation of the uterus for pregnancy.

Overall, prostaglandins play a critical role in regulating various physiological processes, including pain and inflammation, blood flow, stomach protection, labor and delivery, and fertility. Imbalances in prostaglandin levels can lead to various conditions, including pain, inflammation, and reproductive disorders.

Chapter-12 | Chemotherapeutic Agents

Chemotherapeutic Agents: Introduction, basic principles of chemotherapy of infections, infestations and neoplastic diseases, Classification, dose, indication and contraindications of drugs belonging to

Unit-1

- Penicillins
- Cephalosporins
- Aminoglycosides
- Fluoroquinolones
- Macrolides
- Tetracyclines
- Sulphonamides
- Anti-tubercular drugs
- Anti-fungal drugs
- Anti-viral drugs
- Anti-amoebic agents
- Anthelmintics
- Anti-malarial agents
- Anti-neoplastic agents

Chemotherapeutic Agents:

- Chemotherapeutic agents are drugs that are used to treat cancer.
- They work by interfering with the growth and division of cancer cells, either by killing the cells outright or by preventing them from multiplying.
- Chemotherapy can be given as a standalone treatment or in combination with other treatments such as radiation therapy or surgery.
- Chemotherapy can be very effective in treating cancer, it can also cause a range of side effects such as nausea, hair loss, and fatigue.

There are many different types of chemotherapeutic agents.

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1. Alkylating agents: These drugs work by damaging the DNA inside cancer cells, preventing them from dividing and reproducing.
2. Antimetabolites: These drugs work by interfering with the cancer cell's ability to make DNA, RNA, and other essential components needed for growth and division.
3. Anthracyclines: These drugs work by binding to the DNA inside cancer cells, preventing them from replicating and dividing.
4. Topoisomerase inhibitors: These drugs work by preventing the enzyme topoisomerase from working properly, which is needed for DNA replication.
5. Mitotic inhibitors: These drugs work by interfering with the mitotic spindle, which is needed for cell division.

Principles of chemotherapy:

The principles of chemotherapy involve using drugs to kill or slow the growth of cancer cells. The following are some of the key principles of chemotherapy:

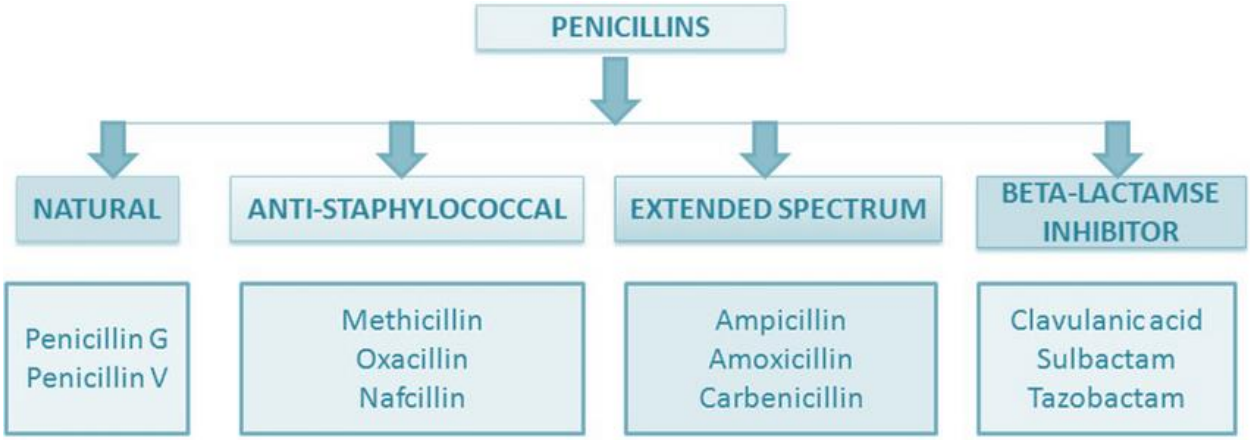
1. Cytotoxicity: Chemotherapy drugs work by targeting rapidly dividing cells, including cancer cells. They disrupt the normal cell division process, which can lead to cell death.
2. Systemic treatment: Chemotherapy drugs are typically given systemically, meaning they travel through the bloodstream to reach cancer cells throughout the body. This allows chemotherapy to treat cancer cells that may have spread beyond the initial tumor site.
3. Combination therapy: Often, chemotherapy drugs are given in combination with other drugs or treatments, such as surgery or radiation therapy. This can increase the effectiveness of treatment and help to prevent the development of drug resistance.
4. Dose and schedule: The dose and schedule of chemotherapy drugs are carefully chosen to balance effectiveness with minimizing side effects. The drugs are typically given in cycles, with rest periods in between to allow the body to recover.
5. Adjuvant therapy: Chemotherapy may be used as adjuvant therapy, meaning it is given after surgery or radiation therapy to help reduce the risk of cancer recurrence.

Penicillins:

- Penicillins are antibiotics that got their name from the Penicillium mold, from which they were originally extracted.

- They belong to the pharmacological group of beta-lactam antibiotics, because they have a beta-lactam ring in their structure.
- Penicillins work by preventing the bacteria from forming a cell wall, which is essential for their survival. This causes the bacteria to burst and die.

Classification of penicillin:



1. Penicillin G: This is the original form of penicillin and is used to treat many types of infections, including strep throat, pneumonia, and syphilis.
2. Ampicillin: This is a broad-spectrum penicillin that is used to treat a wide range of infections, including urinary tract infections, respiratory infections, and ear infections.
3. Amoxicillin: This is a more commonly used penicillin that is used to treat bacterial infections such as ear infections, urinary tract infections, and respiratory infections.
4. Augmentin: This is a combination of amoxicillin and clavulanic acid, which is used to treat more resistant bacteria and infections.

Dose:

- Penicillins (except bacampicillin tablets, amoxicillin, penicillin V, pivampicillin, and pivmecillinam) are best taken with a full glass (8 ounces) of water on an empty stomach (either 1 hour before or 2 hours after meals) unless otherwise directed by your doctor.

Indications:

- Upper respiratory infections
- Otitis media
- Pneumonia
- Rheumatic fever
- Erysipelas
- Skin and soft-tissue infections
- Gonorrhea

- Syphilis

Contraindications:

- Hypersensitivity to penicillins.

Cephalosporins:

- Cephalosporins are the largest group of beta-lactam antibiotics, cover a broad range of organisms, are generally well-tolerated, are easy to administer, and are thus frequently used.
- The classification, spectrum of activity, and pharmacology of the cephalosporins will be reviewed here.
- The spectrum of activity of cephalosporins combined with beta-lactamase inhibitors are discussed separately.
- The mechanisms of action and resistance and major adverse reactions of the beta-lactam antibiotics, and the penicillins and other beta-lactam drugs are also discussed separately.

Classification of Cephalosporins:

1. **First Generation Cephalosporins:**
   - Cefazolin
   - Cephalexin
   - Cefadroxil
2. **Second Generation Cephalosporins:**
   - Cefuroxime
   - Cefaclor
   - Cefprozil
   - Cefoxitin
3. **Third Generation Cephalosporins:**
   - Ceftriaxone
   - Cefotaxime
   - Ceftazidime
   - Cefixime
   - Cefpodoxime
   - Ceftibuten
4. **Fourth Generation Cephalosporins:**
   - Cefepime
   - Cefpirome
5. **Fifth Generation Cephalosporins:**
   - Ceftaroline
   - Ceftobiprole

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Cefazolin:

- Cefazolin is used to treat bacterial infections in many different parts of the body. This medicine is also given before certain types of surgery to prevent infections.
- Cefazolin belongs to the class of medicines known as cephalosporin antibiotics. It works by killing bacteria or preventing their growth. However, this medicine will not work for colds, flu, or other virus infections.

Dose:

- For adults: 1 to 2 grams given every 8 hours (directed by the healthcare provider)
- For children: 25 to 50 mg per kilogram of body weight per day, divided into 3 or 4 doses (directed by the healthcare provider)

Indications:

- Skin and soft tissue infections
- Urinary tract infections
- Respiratory tract infections
- Bone and joint infections
- Endocarditis

Contraindication:

- Diarrhea
- Nausea
- Vomiting
- Indigestion
- Stomach pain
- Vaginal itching or discharge.

Aminoglycosides:

Aminoglycosides are a class of antibiotics that are derived from Streptomyces bacteria. Amikin (amikacin) is an aminoglycoside antibiotic used to treat serious bacterial infections.

Classification:

1. Systemic:

- Streptomycin
- Amikacin
- Gentamicin

- Kanamycin
- Netilmicin
- Tobramycin
- Sisomicin

2. Topical:

- Neomycin
- Framycetin

Streptomycin:

- Streptomycin belongs to a class of drugs known as aminoglycoside antibiotics.
- It works by killing the organisms that cause the infection.
- This drug may also be used to treat other serious infections (such as Mycobacterium avium complex-MAC, tularemia, endocarditis, plague) along with other medications.

Dose:

Daily	Twice Weekly	Twice Weekly
Children	20-40mg /kg	25-30 mg/kg
	Max 1 g	Max 1.5 g
Adults	15 mg/kg	25-30 mg/kg
	Max 1 g	Max 1.5 g

Indication:

- Tuberculosis
- Tularemia
- Plague

Contraindications:

- Hypersensitivity
- Neuromuscular disorders
- Renal impairment
- Pregnancy and breastfeeding

Fluoroquinolones:

Fluoroquinolones are highly effective antibiotics with many advantageous pharmacokinetic properties including high oral bioavailability, large volume of distribution, and broad-spectrum antimicrobial activity. With widespread use, antimicrobial resistance to fluoroquinolones has grown.

Classification of Fluoroquinolones:

1. First-generation fluoroquinolones:

- Ciprofloxacin (Cipro)
- Norfloxacin (Noroxin)

2. Second-generation fluoroquinolones:

- Levofloxacin (Levaquin)
- Ofloxacin (Floxin)

3. Third-generation fluoroquinolones:

- Gemifloxacin (Factive)
- Moxifloxacin (Avelox)
- Delafloxacin (Baxdela)

4. Fourth-generation fluoroquinolones:

- Besifloxacin (Besivance)
- Gatifloxacin (Tequin)
- Sparfloxacin (Zagam)

Ciprofloxacin:

Ciprofloxacin is a broad-spectrum antibiotic that belongs to the fluoroquinolone class. It is used to treat a variety of bacterial infections, including urinary tract infections, respiratory infections, skin infections, and gastrointestinal infections, among others.

Dose:

For gonorrhea:

- Adults—250 milligrams (mg) taken as a single dose.

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- Children—Use and dose must be determined by your doctor.

For other infections:

- Adults—250 to 750 milligrams (mg) 2 times a day, taken every 12 hours.
- Children—Use and dose must be determined by your doctor.

Indication:

- Typhoid fever
- Gonorrhea
- Diarrhea
- Urinary tract infections
- Sexually transmitted infections

Contraindication:

- Nausea, Diarrhea, Headache, Dizziness, And Rash.
- More serious side effects are rare but can include tendon ruptures, central nervous system effects, and allergic reactions.

Macrolides:

- Macrolides are a class of drugs used to manage and treat various bacterial infections.
- They are also used in uncomplicated skin infections and otitis media in pediatric patients.

Classification of Macrolides:

Macrolides

- Erythromycin
- Clarithromycin
- Azithromycin
- Roxithromycin
- Spiramycin

Ketolides

- Telithromycin

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- Erythromycin: This is the first macrolide antibiotic that was discovered. It is commonly used to treat respiratory tract infections, skin infections, and sexually transmitted infections. It is also used to treat some forms of acne.
- Azithromycin: This is a newer macrolide antibiotic that is commonly used to treat respiratory tract infections, skin infections, and sexually transmitted infections. It is also used to treat some forms of traveler's diarrhea.
- Clarithromycin: This is another newer macrolide antibiotic that is commonly used to treat respiratory tract infections, skin infections, and sexually transmitted infections. It is also used to treat some forms of stomach ulcers.
- Telithromycin: This is a newer macrolide antibiotic that is commonly used to treat respiratory tract infections. It is also used to treat some forms of community-acquired pneumonia.
- Spiramycin: This macrolide antibiotic is commonly used to treat toxoplasmosis and some sexually transmitted infections.

Dose:

Erythromycin:

- Adults is 250-500 mg orally every 6 hours or 500-1000 mg orally every 12 hours.
- Children, the dose is usually 30-50 mg/kg/day in divided doses.

Azithromycin:

- Adult is 500-1000 mg orally once daily for 3-5 days.
- Children, the dose is usually 10-30 mg/kg/day in a single daily dose for 3-5 days.

Indications of Macrolides:

- Bronchitis
- Pneumonia
- Sinusitis
- Skin infections
- Stomach ulcers
- Stomach ulcers

Contraindications:

- Hypersensitivity
- Liver or kidney disease

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- Myasthenia gravis
- Pregnancy and breastfeeding

Tetracyclines:

- Tetracycline is used to treat infections caused by bacteria including pneumonia and other respiratory tract infections; ; certain infections of skin, eye, lymphatic, intestinal, genital and urinary systems; and certain other infections that are spread by ticks, lice, mites, and infected animals.
- It is also used along with other medications to treat acne.
- Tetracycline will not work for colds, flu, or other viral infections.

Classification of Tetracyclines:

1. First-generation tetracyclines:
   - Tetracycline hydrochloride
   - Achromycin
   - Sumycin
   - Panmycin
2. Second-generation tetracyclines:
   - Doxycycline
   - Vibramycin
   - Adoxa
   - Monodox
3. Third-generation tetracyclines:
   - Tigecycline
   - Tygacil

Dose:

- Tetracycline: For adults 250-500 mg every 6 hours
- Doxycycline: 100 mg twice a day or 200 mg once a day.
- Minocycline: 100-200 mg once or twice a day.

Indications:

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- Acne
- Chlamydia
- Non-gonococcal urethritis
- Trachoma
- Lymphogranuloma venereum
- Plague
- Respiratory tract infections
- Certain infections of skin
- Eye
- Lymphatic
- Intestinal, genital and urinary systems

Contraindication:

- Contraindicated in pregnancy because of the risk of hepatotoxicity in the mother, the potential for permanent discoloration of teeth in the fetus (yellow or brown in appearance), as well as impairment of fetal long bone growth.
- Tetracyclines usually are not used in young children because tetracyclines can permanently stain teeth.
- This drug is contraindicated in persons who have shown hypersensitivity to any of the tetracyclines, in children<8 years. Avoid in complete renal failure. Use with caution in patients with hepatic dysfunction.

Sulphonamides:

- Sulfonamides or sulfa drugs are a class of antibiotics that target bacteria causing infections.
- These classes of drugs are generally broad-spectrum antibiotics that act on a wide range of bacterial types and are therefore employed in treating many kinds of bacterial infections.
- Sulphonamides do not kill bacteria, but it interferes with the ability of bacteria to grow and multiply (bacteriostatic).

Classification of Sulphonamides:

1. Short-acting sulfonamides:
    - Sulfisoxazole
    - Sulfamethoxazole
    - Sulfadiazine
2. Intermediate-acting sulfonamides:

- Sulfadimidine
- Sulfamethazine
- Sulfamoxole

3. Long-acting sulfonamides:
    - Sulfadoxine
    - Sulfamethoxypyridazine
    - Sulfasalazine
4. Topical sulfonamides:
    - Silver sulfadiazine
    - Mafenide

Dose:

1. Short-acting sulfonamides:
    - Sulfisoxazole: 500-1000 mg orally 2-4 times daily
    - Sulfamethoxazole: 800 mg orally twice daily
    - Sulfadiazine: 1-1.5 grams orally 3-4 times daily
2. Intermediate-acting sulfonamides:
    - Sulfadimidine: 500-1000 mg orally 3-4 times daily
    - Sulfamethazine: 1 gram orally twice daily
    - Sulfamoxole: 1-2 grams orally daily in divided doses
3. Long-acting sulfonamides:
    - Sulfadoxine: 1 gram orally as a single dose
    - Sulfamethoxypyridazine: 500 mg orally twice daily
    - Sulfasalazine: 1-2 grams orally daily in divided doses

Indication:

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- Urinary tract infections (UTIs)
- Malaria
- Toxoplasmosis
- Rheumatoid arthritis
- Otitis media,
- Acute exacerbations of chronic bronchitis,
- Diarrhea.

Contraindication:

- Allergy
- Renal impairment

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Anti-tubercular drugs:

Anti-tubercular drugs are a group of medications used in the treatment of tuberculosis (TB), a bacterial infection caused by Mycobacterium tuberculosis.

Classification of Anti-tubercular Drugs:

1. First-line drugs:
    - Isoniazid
    - Rifampin
    - Ethambutol
    - Pyrazinamide
2. Second-line drugs:
    - Streptomycin
    - Kanamycin
    - Capreomycin
    - Amikacin
3. Other drugs:
    - Bedaquiline
    - Delamanid
    - Linezolid

Dose:

1. Isoniazid (INH):
    - Adult dose: 5 mg/kg to 15 mg/kg of body weight, up to a maximum of 300 mg per day
    - Pediatric dose: 10 mg/kg to 20 mg/kg of body weight, up to a maximum of 300 mg per day
2. Rifampin (RIF):
    - Adult dose: 10 mg/kg to 20 mg/kg of body weight, up to a maximum of 600 mg per day

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- Pediatric dose: 10 mg/kg to 20 mg/kg of body weight, up to a maximum of 600 mg per day

3. Ethambutol (EMB):
    - Adult dose: 15 mg/kg to 25 mg/kg of body weight, up to a maximum of 1,200 mg per day
    - Pediatric dose: 15 mg/kg to 25 mg/kg of body weight, up to a maximum of 1,200 mg per day
4. Pyrazinamide (PZA):
    - Adult dose: 15 mg/kg to 30 mg/kg of body weight, up to a maximum of 2,000 mg per day
    - Pediatric dose: 15 mg/kg to 30 mg/kg of body weight, up to a maximum of 2,000 mg per day

Indications of anti-tubercular drugs:

- Tuberculosis
- Gaucher's disease
- Mycobacterium avium

Contraindication

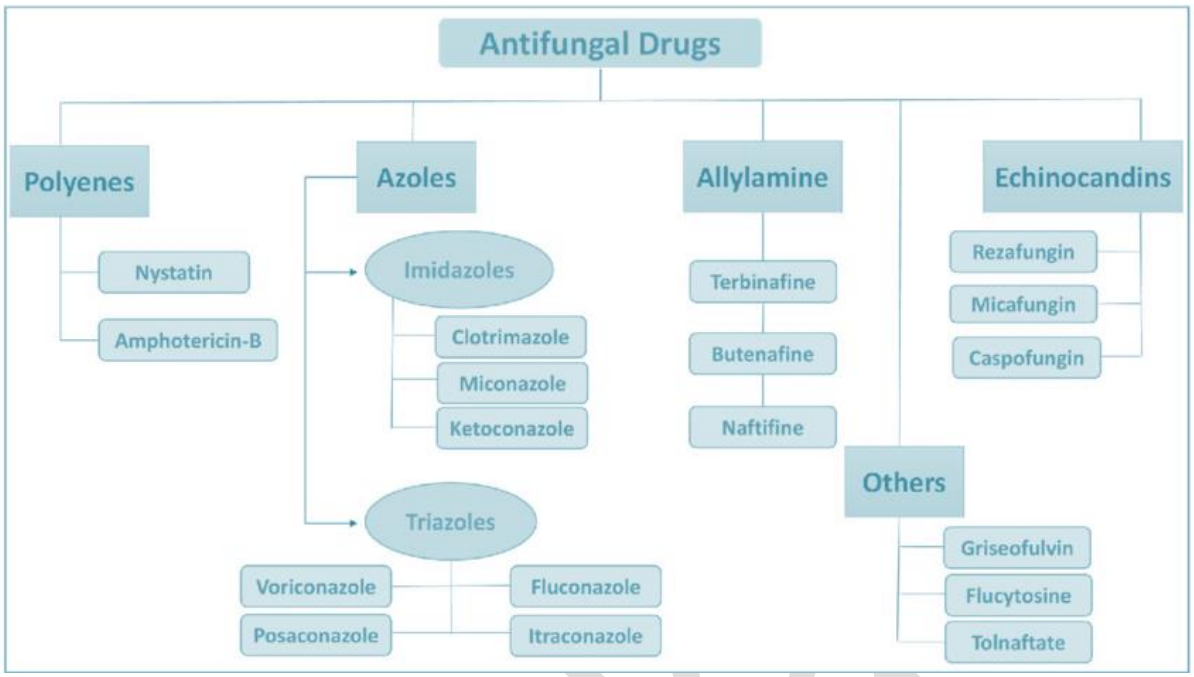
- Diarrhea
- Nausea
- Vomiting
- Abdominal pain
- Headache
- Muscle/joint pain
- Upset stomach
- Heartburn

Anti-fungal drugs:

Antifungal medicines are used to treat fungal infections, which most commonly affect your skin, hair and nails.

Fungal infections can occur in various parts of the body, such as the skin, nails, hair, mouth, throat, and genitals. Some fungal infections can be serious, especially in people with weakened immune systems or underlying medical conditions.

Classification of antifungal drugs:



Dose:

- Fluconazole: 150-400 mg orally once daily
- Itraconazole: 200-400 mg
- Posaconazole: 300 mg orally twice daily
- Amphotericin B: given intravenously, and the dose can range from 0.3-1.5 mg/kg/day.
- Caspofungin: 70 mg intravenously once on the first day.
- Terbinafine: 250 mg orally once daily for 2-4 weeks

Indications:

- Fungal infections
- Onychomycosis
- Tinea capitis
- Cryptococcosis
- Prophylaxis

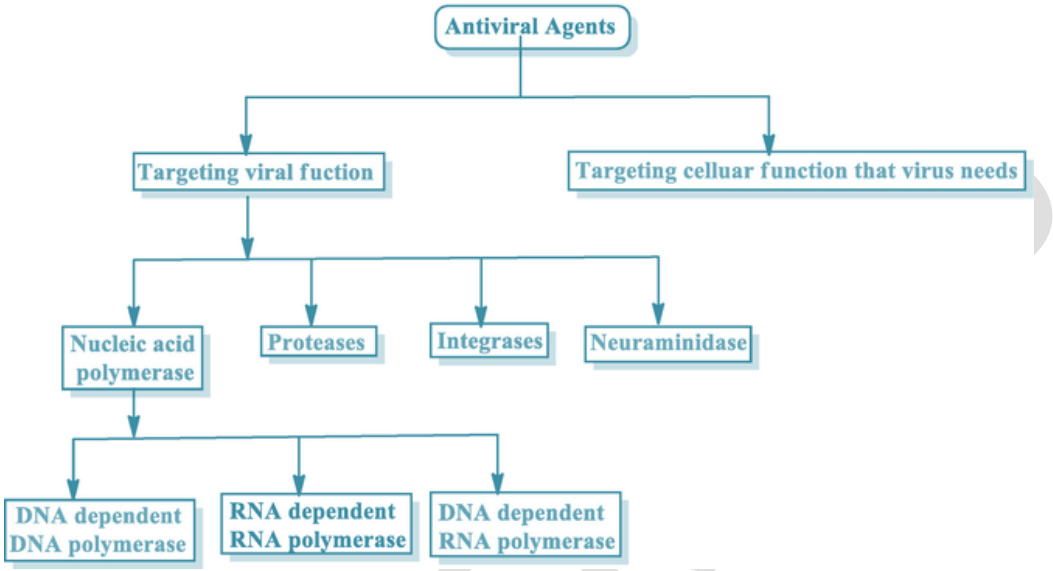
Contraindication:

- Hypersensitivity
- Hepatic dysfunction
- Endocrine or fertility problems

Anti-viral drugs

Antiviral drugs are medications used to treat viral infections. Most antivirals target specific viruses, while a broad-spectrum antiviral is effective against a wide range of viruses.

Classification of Anti-viral drugs:



Dose of Anti-viral drugs:

- Acyclovir: Adults is 200 mg five times daily or 400 mg three times daily for 5-10 days.
- Oseltamivir: Adults and adolescents weighing 40 kg or more is 75 mg twice daily for 5 days.
- Ribavirin: Oral dose for adults is 600 mg twice daily for 3-7 days.

Indication of Anti-viral drugs:

- Acyclovir
- Valacyclovir
- Famciclovir
- Oseltamivir
- Zanamivir
- Ribavirin
- Interferon-alpha

- Sofosbuvir
- Ledipasvir/sofosbuvir
- Lopinavir/ritonavir

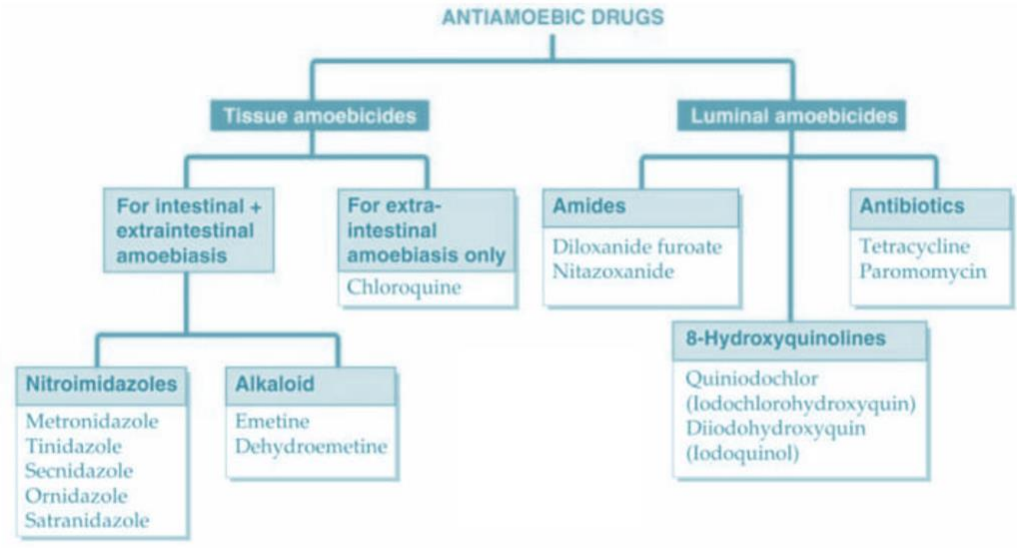
Contraindications of Antiviral drugs:

- Decompensate psychiatric disease
- Decompensate diabetes mellitus
- Decompensate arterial hypertension
- Decompensate hemoglobinopathy
- Decompensate autoimmune diseases

Anti-amoebic agents:

Antiamoebic agents are compounds of drugs used to cure amoebiasis, a parasitic illness carried by a protozoan that causes intestinal amebiasis and extraintestinal manifestations.

Classification of Anti-amoebic agents:



Dose of Anti-amoebic agents:

- Metronidazole: Adults—500 or 750 milligrams (mg) 3 times a day for 5 to 10 days
- IV: 15 mg/kg
- Capsule: 375mg

Indication:

- Infections of the reproductive system, gastrointestinal (GI) tract, skin, heart, bone, joint, lung, blood, nervous system, and other areas of the body.
- Anaerobic infections
- Bacterial vaginosis

Contraindications:

Individuals who have encountered certain blood disorders, pregnant women, and alcoholics are advised against consuming antiamoebic agents.

Anthelmintics:

Anthelmintics are a class of drugs used to treat infections caused by parasitic worms, also known as helminths. These worms can infect humans and animals and can cause a variety of symptoms ranging from mild discomfort to severe illness.

Classification of anthelmintics

- Piperazines: Diethylcarbamazine citrate (DEC), Piperazine citrate.
- Benzimidazoles: Albendazole, Mebendazole, Thiabendazole.
- Heterocyclics: Oxamniquine, Praziquantel.
- Natural products: Ivermectin, Avermectin.
- Vinyl pyrimidines: Pyrantel, Oxantel.
- Amide: Niclosamide.
- Nitro derivative: Niridazole.
- Imidazo thiazole: Levamisole.

Dose:

- Albendazole: 400 mg taken once daily for 1-3 days for most types of infections.
- Mebendazole is 100 mg taken twice daily for 3 days for most types of infections. For whipworm infections
- Pyrantel is 11 mg/kg (up to a maximum of 1 g) taken as a single dose for most types of infections.

Indications:

- Roundworm, hookworm, and whipworm infections.
- Lymphatic filariasis:
- Onchocerciasis
- Schistosomiasis
- Threadworm infections

- Veterinary use: Anthelmintics are also commonly used to treat parasitic infections in livestock and pets.

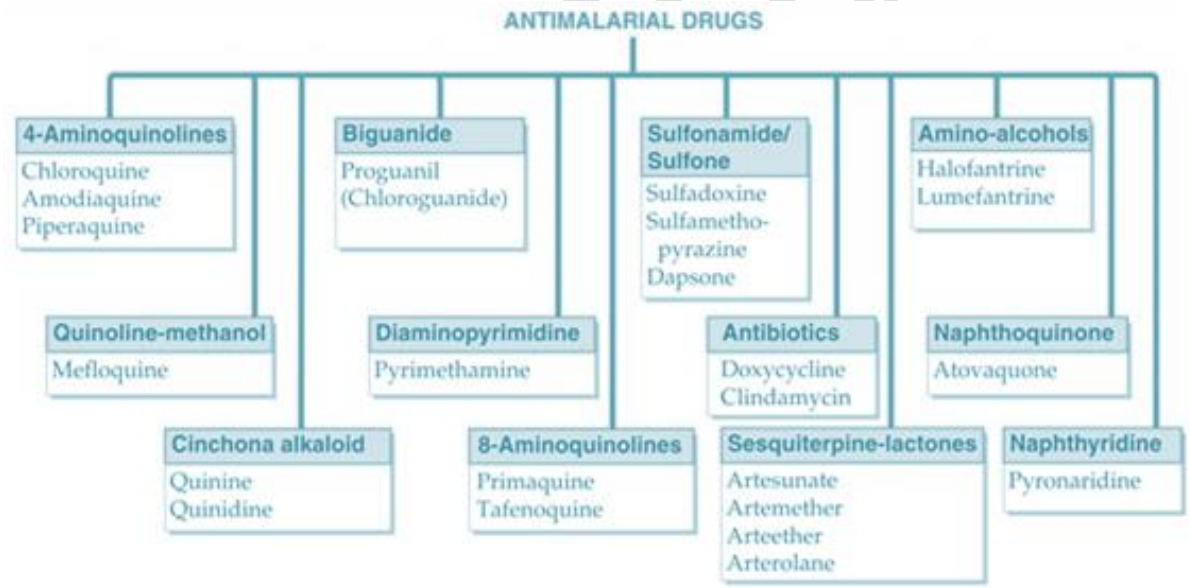
Contraindications:

- Pregnancy
- Breastfeeding
- Severe diarrhea
- Malnourishment
- Hepatic or renal disease

Anti-malarial agents:

Anti-malarial agents are drugs used to prevent or treat malaria, a parasitic disease transmitted by infected mosquitoes.

Classification of Anti-malarial agents:



Dose:

- Chloroquine: Adults- 500 mg once a week for malaria.
- Quinine: Adults- 600 mg every 8 hours for 7 to 10 days for treatment of malaria.
- Mefloquine: Adults- 250 mg once a week.

Indications:

- Malaria
- Pneumocystis carinii pneumonia

- Amebiasis, extraintestinal
- Rheumatoid arthritis
- Systemic lupus erythematosus
- Toxoplasmosis
- Arrhythmias

Contraindication:

- Nausea and vomiting
- Headache
- Dizziness
- Fatigue
- Malaise (feeling of discomfort)
- Muscular pain (Myalgia)
- Diarrhea, Cough, Fever and chills

Anti-neoplastic agents:

The antineoplastic agents or anticancer drugs represent a large and diverse class of medications. They generally have limited but important uses, and often have significant hepatotoxicity.

Classifcation:

- Alkylating Agents
    - Altretamine, Bendamustine, Busulfan, Carmustine, Chlorambucil, Cyclophosphamide, D acarbazine, Ifosfamide, Trabectedin
    - Platinum Coordination Complexes
        - Carboplatin, Cisplatin
- Antibiotics, Cytotoxic
    - Bleomycin, Dactinomycin, Daunorubicin, Doxorubicin
- Antimetabolites
    - Antifolates: Methotrexate, Pemetrexed, Pralatrexate, Trimetrexate
    - Purine Analogues: Azathioprine, Cladribine, Fludarabine, Mercaptopurine, Thioguanine
    - Pyrimidine Analogues: Azacitidine, Capecitabine, Cytarabine,
- Biologic Response Modifiers
    - Aldesleukin (IL-2), Denileukin Diftitox,
- Histone Deacetylase Inhibitors

  - Belinostat, Panobinostat, Romidepsin, Vorinostat

- Hormonal Agents
  - Antiandrogens: Abiraterone, Apalutamide, Bicalutamide, Cyproterone, Enzalutamide
  - Antiestrogens (including Aromatase Inhibitors): Anastrozole, Exemestane, Fulvestrant, Letrozole, Raloxifene, Tamoxifen, Toremifene
  - Gonadotropin Releasing Hormone Analogues: Degarelix, Goserelin, Histrelin, Leuprolide, Triptorelin
  - Peptide Hormones: Lanreotide, Octreotide, Pasireotide
- Monoclonal Antibodies
  - Alemtuzumab, Tremelimumab
- Protein Kinase Inhibitors
  - Abemaciclib, Acalabrutinib, Afatinib, Alectinib, Alpelisib, Axitinib, Ruxolitinib.
- Taxanes
  - Cabazitaxel, Docetaxel, Paclitaxel
- Topoisomerase Inhibitors
  - Etoposide, Irinotecan, Teniposide, Topotecan
- Vinca Alkaloids
  - Vinblastine, Vincristine, Vinorelbine
- Miscellaneous
  - Asparaginase(Pegaspargase), Bexarotene, Eribulin, Everolimus,

Dose:

- Vinblastine: adult dose is 6 mg/m2 to 10 mg/m2 once a week.
- Vincristine: This drug is also typically given by IV injection, and the usual adult dose is 1.4 mg/m2 to 2.0 mg/m2 once a week.
- Vinorelbine: This drug may be given by IV injection or by mouth, and the usual adult dose is 25 mg/m2 to 30 mg/m2 once a week.
- Altretamine: Capsule 50mg

Indications:

- Lymphoma,
- Leukemia,
- Melanoma,
- Solid tumor

Drug (generic name)	Dose	Indication
Cisplatin	20 mg/m² I.V	Metastatic testicular tumors
	50–70 mg/m² I.V	Advanced bladder carcinoma
	70–100 mg/m² I.V	Metastatic ovarian carcinoma
Mechlorethamine	0.4 mg/kg O.D intracavity, 0.2 mg/kg intrapericardial	Metastatic carcinoma Leukemia lymphomas polycythemia
	MOPP regimen 6mg/m²/day I.V	
Methotrexate	15–30 mg/day	Trophoblastic neoplasms
	12 mg/m² I.V	Meningeal leukemia, osteosarcoma
	40 mg/m &sup 2 I.V	Breast cancer, head and neck cancer
6-mercaptopurine	1.5–2.5 mg/kg orally O.D	ALL
5-FU	500 mg/sq.m I.V, 450–600 mg/sq.m I.V weekly, 200–400 mg/sq.m I.V continuous infusion (QD) do not exceed 800 mg/day	Cancers of colon, breast, ovary, liver, pancreas, rectum, and stomach
Bleomycin	0.25–0.5 units/kg I.V, I.M or SC weekly/twice weekly.	Head and neck cancer, leukemias, lymphomas, prostate cancer, and respiratory and thoracic cancer
Doxorubicin	50 mg/m² I.V Q 4 weeks	Ovarian cancer
	30 mg/m² I.V on day 4 following 1.3 mg/m² on days 1,4,8,11 & q 3 weeks	Multiple myeloma
Vincristine	1.4 mg/m² I.V q week	Acute leukemia
Paclitaxel	175 mg/m² I.V over 3 hours every 3 weeks	Breast cancer, metastatic breast cancer
Etoposide	50–100 mg/m²/day I.V, 100 mg/m²/day I.V on days 1,3,5 repeat q 3–4 weeks	Testicular cancer Small-cell lung cancer
	35 mg/m²/day I.V for 4 days	
Tamoxifen	20–40 mg/day PO, doses>20 mg/day should be divided BID (morning and evening)	Breast cancer
Adalimumab	375 mg/m² I.V infusion in relapsed or refractory low-grade or follicular, CD20 positive, B-cell NHL once weekly×4 doses	Non-Hodgkin's lymphoma Chronic lymphocytic leukemia
	In combination therapy with FC, 375 mg/m² I.V infusion on day 1 1st cycle then 500 mg/m² on day 1 of subsequent cycles	

Contraindication:

- Pregnancy and lactation.
- Known allergy to drugs.
- Bone marrow suppression.
- Suppressed renal or hepatic function.
- Pulmonary problems.
- Cardiac problems.

Chapter-13 | Pharmacology | Biologicals

Biologicals Definition, types and indications of biological agents with examples

Biologicals:

- Biologicals, also known as biologics, refer to medical products derived from living organisms or their derivatives.
- Biologicals, are those class of medicines which are grown and then purified from large-scale cell cultures of bacteria or yeast, or plant or animal cells.
- Biologicals are a diverse group of medicines which includes vaccines, growth factors, immune modulators, monoclonal antibodies, as well as products derived from human blood and plasma.
- What distinguishes biologicals from other medicines is that these are generally proteins purified from living culture systems or from blood, whereas other medicines are considered as 'small molecules' and are either made synthetically or purified from plants.
- This can include proteins, vaccines, gene therapies, and monoclonal antibodies, among others. Biologics are used to treat a wide range of diseases, including cancer, autoimmune disorders, and infectious diseases.
- They differ from traditional small-molecule drugs in their complexity and the manner in which they act on the body.

Sources Of Biologicals

- Mammalian cell cultue
- Humans
- Avian cell culture
- Mice
- Transgenics
- Insect cell culture

Steps Involved In Production:

1. Develop Host: A host cell is developed by isolating the DNA sequence that codes for the desired protein,
2. Establish a Cell Bank: A cell bank is then established using elaborate cell screening and selection process
3. Protein Production System: The "engineered" cells are then cultured on a large scale under growth conditions to optimize cellular production
4. Purification: Fractions containing the desired protein are harvested and isolated, and the undesired proteins and impurities are separate

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5. Analysis: Protein molecules are analyzed for uniformity in terms of structure, character, and potency;
6. Formulation: Therapeutic protein is then formulated

Types of Biologicals:

There are several different types of biologicals, including:

1. **Proteins:** Examples include insulin for diabetes and erythropoietin for anemia.
2. **Vaccines:** These are used to prevent the spread of infectious diseases.
3. **Gene therapies:** These involve the introduction of a functional gene into a patient's cells to treat genetic disorders.
4. **Monoclonal antibodies:** These are laboratory-made molecules that mimic the immune system's ability to fight off harmful substances.
5. **Cell therapies:** These involve the transplantation of living cells into a patient's body to treat diseases or conditions.
6. **Toxoids:** These are toxins that have been made harmless and used as vaccines against certain bacterial diseases.
7. **Fusion proteins:** These are made by combining two different proteins to treat diseases such as arthritis and cancer.
8. **Recombinant DNA products:** These are produced using genetic engineering techniques and used to treat a range of conditions, including hemophilia and growth hormone deficiencies.

Indications of biological agents with examples:

Here are some indications for biological agents along with examples:

1. **Cancer:**
   - Monoclonal antibodies such as trastuzumab (Herceptin) are used to treat breast cancer.
   - Cell therapies such as chimeric antigen receptor T cell (CAR-T) therapy are used to treat certain types of blood cancers.
2. **Autoimmune disorders:**
   - Monoclonal antibodies such as adalimumab (Humira) are used to treat rheumatoid arthritis.
   - Fusion proteins such as etanercept (Enbrel) are used to treat psoriatic arthritis and ankylosing spondylitis.

3. **Infectious diseases:**
    - Vaccines such as HPV vaccine and influenza vaccine are used to prevent the spread of the respective diseases.
    - Monoclonal antibodies such as infliximab (Remicade) are used to treat viral infections such as hepatitis B and C.
4. **Hormonal deficiencies:**
    - Recombinant DNA products such as human growth hormone (HGH) are used to treat growth hormone deficiency.
    - Insulin is used to treat diabetes.
5. **Genetic disorders:**
    - Gene therapies such as lentiviral vector gene therapy are used to treat severe combined immunodeficiency.
    - Stem cell transplantation is used to treat genetic blood disorders such as sickle cell anemia.
6. **Neurological disorders:**
    - Monoclonal antibodies such as ocrelizumab (Ocrevus) are used to treat multiple sclerosis.
7. **Inflammatory disorders:**
    - Fusion proteins such as infliximab (Remicade) are used to treat inflammatory bowel diseases such as Crohn's disease and ulcerative colitis.
8. **Allergic conditions:**
    - Monoclonal antibodies such as omalizumab (Xolair) are used to treat severe asthma and allergic rhinitis.

These are some examples of the indications for biological agents. It's important to note that each biological agent is specific to certain conditions and not all biological agents are approved for all indications. Consult with a healthcare professional for personalized medical advice.

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