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SECTION

1

Pharmacology

→ **Complete Topic**

GENERAL PHARMACOLOGY

SCIENTIST NAME AND THEIR DISCOVERIES

| S.NO. | DISCOVERIES | SCIENTIST |
|-------|--|---------------------|
| 1. | Father of Pharmacology | Oswald Schimedeberg |
| 2. | Founded first institute of pharmacology | Rudolf Buicheim |
| 3. | First pharmacist (father of pharmacy) | Galen |
| 4. | Father of chemotherapy | Paul Ehrlich |
| 5. | Discovery of Penicillin | Alexander Fleming |
| 6. | Discovery of Streptomycin | Selman Waksman |
| 7. | Discovery of Insulin | Banting and Best |
| 8. | Discovery of antimicrobial effect of prontosil | Gerhard Domagk |
| 9. | Father of medicine | Hippocrates |

ESSENTIAL MEDICINES

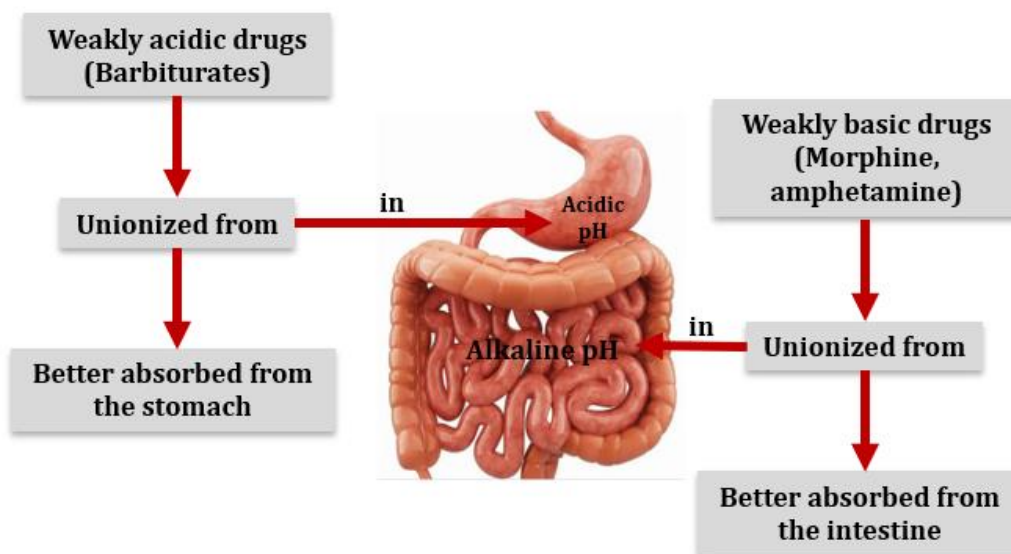
- E → Effective and economical
- S → Safe
- S → Single drug formulation mostly
- E → Environmental factor are also considered in making the choice
- N → Needed by the majority of population
- T → They must be available at all times
- I → In proper dosage form
- A → Aim is to optimally use the limited financial resources
- L → List of essential drugs is made locally with the help of WHO model list

| ORPHAN DRUGS | OVER THE COUNTER DRUGS | PRESCRIPTION DRUGS |
|--|---|--|
| Drugs that are used for the diagnosis, treatment or prevention of rare diseases | These drugs can be sold to a patient without the need for a doctor's prescription | These are drugs which can be obtained only upon producing the prescription of a RPM. |
| "SR DDLG Ka FAN Hai" S → Sumatriptan R → Rifabutin D → Digoxin immune fab L → Liothyronine (T3) F → Fomipizole A → Amphoteracin B N → Nitrates | e.g., Paracetamol, antacids etc. | e.g., antibiotics, antipsychotics etc. |

SOURCES OF DRUG INFORMATION

| | |
|--|---|
| <p>Pore Transport</p> | <ul style="list-style-type: none"> • Also called as convective transport, bulk flow or filtration. • Passage of drugs through aqueous pores in the membrane or through paracellular spaces. • Important in the absorption of low molecular weight (less than 100). • Drugs with MW > 100 or 200 are not able to penetrate. |
| Carrier Mediated Transport | |
| <ul style="list-style-type: none"> • Facilitated diffusion | <ul style="list-style-type: none"> • This is a type of carrier-mediated transport and does not require energy. • The drug attaches to a carrier in the membrane which facilitates its diffusion across the membrane. |
| <ul style="list-style-type: none"> • Active transport | <ul style="list-style-type: none"> • The drug molecules move from a region of lower to higher concentration against the concentration gradient. • It requires energy. • Primary active transport – Energy is obtained directly by the hydrolysis of ATP. • Secondary active transport – <ul style="list-style-type: none"> ▪ When the concentration gradients are such that both the solutes move in the same direction → symport or cotransport ▪ When they move in opposite directions → antiport or exchange transport. |

ABSORPTION OF DRUGS



BIOAVAILABILITY

- It is the fraction of administered drug that reaches the systemic circulation in the unchanged form.
- By i.v. route it is 100%.

HALF LIFE ($t_{1/2}$)

- It is the time required to reduce the plasma concentration to half (50%) of the original value.

$$t_{1/2} = \frac{0.693 \times V_d}{CL}$$

| Half-life | Elimination | Drug left | Half-life of Drugs | Half-life of Drugs |
|-----------------|-------------|-----------|-----------------------|------------------------|
| 1 st | 50% | 50% | Aspirin (4 Hr) | Acyclovir (3 Hr) |
| 2 nd | 75% | 25% | Penicillin G (30 Min) | Griseofulvin (24 Hr) |
| 3 rd | 87.5% | 12.5% | Doxycycline (20 Hr) | Digoxin (40 Hr) |
| 4 th | 93.75% | 3.25% | Cetirizine (10 Hr) | Phenobarbitone (90 Hr) |
| 5 th | 96.875% | 3.125% | Captopril (2 Hr) | Digitoxin (7 days) |

ORDER OF PHARMACOKINETICS

| FIRST ORDER | ZERO ORDER |
|---|---|
| A Constant fraction of drug is eliminated per unit time $100 \text{ mg} \xrightarrow[1/2]{1 \text{ hr}} 50 \text{ mg} \xrightarrow[1/2]{1 \text{ hr}} 25 \text{ mg}$ | A constant amount of drug is eliminated per unit time $100 \text{ mg} \xrightarrow[10 \text{ mg}]{1 \text{ hr}} 80 \text{ mg} \xrightarrow[10 \text{ mg}]{1 \text{ hr}} 60 \text{ mg}$ |
| Rate of elimination directly proportional to plasma concentration. | Rate of elimination is independent of plasma concentration. |
| Clearance is constant | Clearance is inversely proportional to plasma constant $Cl \propto \frac{1}{P}$ |
| $t_{1/2}$ constant Most of the drugs follows 1 st order kinetics | $t_{1/2}$ is directly proportional to plasma concentration |

DRUGS SHOWING ZERO ORDER KINETICS

| TRICK - " Peas and WHEATS" | |
|----------------------------|---------------------------|
| P Peas | Phenytoin, Phenylbutazone |
| W | Warfarin |
| H | Heparin |
| E | Ethanol |
| A | Aspirin |
| T | Theophylline. Tolbutamide |
| S | Salicylates |

STEADY STATE CONCENTRATION

| | |
|-------------------------|--|
| Loading dose | It is mainly used for drugs having long $t_{1/2}$ and large volume of distribution. It is given to load (saturate) the tissue stores. So, it is mainly dependent on V_d . Loading dose = $V_d \times$ Target plasma concentration |
| Maintenance dose | To maintain the plasma concentration smaller dose is given. It is mainly dependent on CL. Maintenance dose = CL \times Target plasma concentration |

DIRECTLY ACTING PARASYMPATHOMIMETIC DRUGS

| Drugs | Description |
|---------------------|---|
| Pilocarpine | <ul style="list-style-type: none"> ➤ It is obtained from the leaves of <i>Pilocarpus microphyllus</i>. ➤ It is a ternary amine ➤ Produces both muscarinic and nicotinic effect. ➤ Pilocarpine is used only in the eye as 0.5– 4% drops. |
| Muscarine | <ul style="list-style-type: none"> ➤ It occurs in poisonous mushrooms <i>Amanita muscaria</i> and <i>Inocybe species</i> and has only muscarinic actions. ➤ Antidote – atropine |
| Arecoline | <ul style="list-style-type: none"> ➤ It is found in betel nut <i>Areca catechu</i> and has muscarinic as well as nicotinic actions. |
| Bethanechol | <ul style="list-style-type: none"> ➤ It has been used in postoperative/ postpartum nonobstructive urinary retention. |
| Methacholine | <ul style="list-style-type: none"> ➤ Maximum action on myocardium |

INDIRECTLY ACTING PARASYMPATHOMIMETIC DRUGS

| Drugs | Description |
|----------------------|---|
| Physostigmine | <ul style="list-style-type: none"> ➤ Ternary amine derivative. ➤ Used in glaucoma and atropine poisoning. |
| Neostigmine | <ul style="list-style-type: none"> ➤ Synthetic anticholinesterase agent. ➤ Quaternary ammonium compound. ➤ Uses – <ul style="list-style-type: none"> - Postoperative urinary retention - First line drug in myasthenia gravis - Curare poisoning |
| Edrophonium | <ul style="list-style-type: none"> ➤ Quaternary ammonium compound. ➤ Resembles neostigmine in action, has a brief duration (10–30 min). ➤ Suitable only as a diagnostic agent for myasthenia gravis. |
| Tacrine | <ul style="list-style-type: none"> ➤ Drug of choice for Alzheimer's disease. ➤ Causes hepatotoxicity. ➤ Now preferred drugs – <ul style="list-style-type: none"> - Donepezil - Rivastigmine - Galantamine |

DRUGS USED IN GLAUCOMA

| Group | Drugs | Mechanism | Adverse effects | Special Points |
|---------------------------------|---|-----------------------|---|--|
| PGF₂α Analogs | Latanoprost Bimatoprost Travoprost Tafluprost Unoprostone | ↑ Uveoscleral outflow | <ul style="list-style-type: none"> • Iris pigmentation • Growth of eyelashes • Reactivation of uveitis (Latanoprost) | <ul style="list-style-type: none"> • Drug of choice for POAG |
| α₂ Agonists | Apraclonidine Brimonidine | ↓ Aqueous formation | <ul style="list-style-type: none"> • Lid retraction • Dry Mouth • Ocular burning and | <ul style="list-style-type: none"> • Brimonidine is less likely to cause ocular allergy |

| | |
|--------------------------|---|
| | <ul style="list-style-type: none"> Bronchial muscles relax (bronchodilation) |
| Glands | Atropine causes - <ul style="list-style-type: none"> Decreased secretion of exocrine glands. Decreases sweat, salivary, tracheobronchial and lacrimal secretion (M3 blockade). Skin and eyes become dry, talking and swallowing may be difficult. |
| Body temperature | <ul style="list-style-type: none"> Rise in body temperature occurs at higher doses. It is due to both inhibition of sweating as well as stimulation of temperature regulating centre in the hypothalamus. |
| Local anaesthetic | <ul style="list-style-type: none"> Atropine has a mild anaesthetic action on the cornea. |

USES AND ADVERSE EFFECTS

| THERAPEUTIC USES OF ATROPINE | ADVERSE EFFECTS OF ATROPINE |
|--|--|
| Trick (ATROPA) A – As mydriatics and cycloplegic T – Traveller’s diarrhoea R – Rapid onset of mushroom poisoning O – Organophosphate poisoning P – Preanaesthetic medication A – Arrhythmia | Trick (DHATURA) D – Dry mouth H – Hot dry skin A – Accommodation paralysis T – Tachycardia U – Urinary retention R – Respiratory depression A – Ataxia (lack of voluntary constriction) |

DRUGS ACTING ON AUTONOMIC GANGLIA

| Class | Sub-class | Drugs |
|--|---|--|
| Ganglionic stimulants | Selective nicotinic agonist | Nicotine, Lobeline, Dimethyl phenyl piperazinium(DMPP), Tetramethyl ammonium (TMA),Varenicline |
| | Nonselective/ muscarinic agonist | Acetylcholine, Carbachol, Pilocarpine, Anticholinesterase, MCN 343-A. |
| Ganglionic blocking agents | Competitive blockers | |
| | Quaternary ammonium compounds | Hexamethonium, Pentolinium |
| | Amines (secondary/tertiary) | Mecamylamine, Pempidine |
| | Monosulfonium compound | Trimethaphan camforsulfonate |
| Persistent depolarizing blocker | Nicotine, Anticholinesterases | |

| | | |
|----------------------|-------------------------------------|---|
| Class III | Amiodarone, | Blockade of myocardial K ⁺ channel thereby prolongation of repolarization of phase 3AP is widened and ERP (Effective refractory period). |
| Class IV | Verapamil | Restrict the influx of calcium ions by blocking voltage sensitive L-type calcium channel. |
| Miscellaneous | Purine nucleotide: Adenosine | It activates ach sensitive K ⁺ channel to accentuate inward rectifier K ⁺ current and cause membrane hyperpolarization through interaction with A1 type of adenosine GPCRs on SA node fibers (pacemaker depression --- bradycardia), on A-V node fibers (prolongation of ERP slowing of conduction) and in atrium (shorting of AP, reduced excitability). Adenosine indirectly reduce Ca ²⁺ current in A-V node. |

ANTIARRHYTHMIC DRUGS CLASSES

| | |
|--|--|
| TRICK = "i M Back with Agent Calci in rhythm" | |
| M | Membrane stabilizing agents (Na channel blockers) |
| Back | Beta blockers (Antiadrenergic agents) |
| Agent | Agents widening AP |
| Calci | Calcium channel blockers |

CLASS-III ANTIARRHYTHMIC DRUGS

| | |
|--------------------------------|------------|
| TRICK=BI_nDAS | |
| B | Bretylum |
| I | Ibutilide |
| n | |
| D | Dofetilide |
| A | Amiodarone |
| S | Sotalol |

ADVERSE EFFECTS OF AMIODARONE

| | |
|---|---|
| Trick =The periphery of My Lung Liver and Cornea is Photosensitive | |
| The | Thyroid (both hypo and hyperthyroidism) |
| Periphery | Peripheral neuropathy |
| My | Myocardial depression |
| Lung | Lung fibrosis |
| Liver and | Liver Toxicity [including cirrhosis] |
| Cornea is | Corneal microdeposits |
| Photosensitive | Photosensitivity |

PHENYTOIN ADVERSE EFFECTS & FETAL HYDANTOIN SYNDROME

| TRICK - "HOT MALIKA" | | TRICK - PCM | |
|----------------------|--|-------------|-----------------------|
| H | Hirsutism, hypertrophy | P | Hypoplastic Phalanges |
| O | Osteomalacia | C | Cleft Lip and palate |
| T | Teratogenicity | M | Microcephaly |
| M | Megaloblastic anaemia | | |
| A | Ataxia & Nystagmus | | |
| L | Lymphadenopathy | | |
| I | Inhibit insulin release (Hyperglycaemia) | | |
| K | Vit. K deficiency | | |
| A | Arrhythmia | | |

SODIUM VALPROATE SIDE EFFECTS

| TRICK - "VALPROATE" | |
|---------------------|---------------------------------|
| V | Vomiting |
| A | Alopecia |
| L | Liver toxicity |
| P | Pancreatitis/ Pancytopenia |
| R | Retention of fats (weight gain) |
| O | Oedema (peripheral edema) |
| A | Appetite increase |
| T | Tremor |
| E | Enzyme inhibitor |

VIGABATRIN

| TRICK = VI GABA TR IN | |
|-----------------------|-----------------------|
| VI | Visual (side effects) |
| GABA | GABA |
| TR | TRansaminase |
| IN | Inhibitors |

DRUGS OF CHOICE

| Type of seizure | DOC |
|------------------------------------|-----------------------|
| Absence seizures | Valproate |
| GTCS (Grand mal) | Valproate |
| Partial seizures | Carbamazepine |
| Atonic (Akinetic) seizures | Valproate |
| Tonic seizures | Valproate |
| Clonic seizures | Valproate |
| Infantile spasms | ACTH |
| Infantile spasms with tuberculosis | Vigabatrin |
| Febrile seizure | Diazepam (per rectal) |
| Status epilepticus | Lorazepam (i.v.) |
| Seizures in eclampsia | Magnesium sulphate |

RELATION BETWEEN T4 AND T3

| T ₃ (TRIIODOTHYRONINE) | T ₄ (THYROXINE) |
|--|---|
| MIT + DIT = T ₃ | DIT + DIT = T ₄ |
| T ₃ is less in circulation | T ₄ is the major circulating hormone |
| Rapid onset of action (t _{1/2} 1-2 day) | Slower onset of action t _{1/2} 7-8 days) |
| Short duration of action | Long duration of action |
| More potent | Less potent |

DISORDERS OF THYROID HORMONES

| Hyperthyroidism | Hypothyroidism |
|--|---|
| <ul style="list-style-type: none"> • Cretinism (Children) • Myxoedema (adult) • Goitre (neck get swallow) | <ul style="list-style-type: none"> • Grave's disease |

THYROID INHIBITORS

| CLASSES | DRUGS |
|-------------------------------------|--|
| Inhibits thyroid hormones synthesis | Propylthiouracil, Methimazole, Carbimazole. |
| Inhibitors of iodide trapping | Thiocyanates, Perchlorates, Nitrates. |
| Inhibits thyroid hormone release | Iodine, Iodides of Na and K, Organic iodides. |
| Destroy thyroid tissue | ¹³¹ I, ¹²⁵ I, ¹²³ I |
| Others | Propranolol, Atenolol, Diltiazem |

DIFFERENCE BETWEEN PROPYLTHIOURACIL AND CARBIMAZOLE

| Propylthiouracil | Carbimazole |
|---|--|
| Dose to dose less potent | About 5 times more potent |
| Highly plasma protein bound | Less bound |
| Less transferred across placenta and in milk | Larger amount cross to foetus and in milk |
| Plasma t _{1/2} - 1-2 hour | 6-10 hours |
| Single dose act for 4-8 hours | 12-24 hours |
| No active metabolite | Produces active metabolic - methimazole |
| Multiple (2-3) daily doses needed | Mostly single daily dose |
| Inhibit peripheral conversion of T ₄ to T ₃ | Dose not inhibit T ₄ to T ₃ conversion |



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DIURETICS WITH THEIR SITE AND MECHANISM OF ACTION

| Diuretics | Site of action | Mechanism of action | Efficacy |
|-----------------------------|---------------------------------------|--|----------|
| Acetazolamide | PCT | Carbonic anhydrase inhibitor | Low |
| Loop diuretics | Thick ascending limb of loop of Henle | Inhibit Na ⁺ -K ⁺ -2I ⁻ cotransport | High |
| Thiazides | Early distal tubule | Inhibit Na ⁺ -Cl ⁻ symport | Medium |
| Potassium sparing diuretics | DT and CD | <ul style="list-style-type: none"> Aldosterone antagonists (spironolactone and eplerenone) Directly acting | Low |
| Mannitol | Loop of Henle and PCT | Osmotic effect | High |

DRUG OF CHOICE (DIURETICS & ANTIDIURETICS)

| Condition | Drug of choice |
|---|--|
| Edema | |
| • Due to CHF | Furosemide |
| • Due to renal disease or nephrotic syndrome | Furosemide |
| • Pulmonary edema | Furosemide |
| • Cerebral edema | Mannitol |
| • Edema due to cirrhosis | Spirolactone |
| Diabetes insipidus | |
| • Central | Desmopressin |
| • Nephrogenic | Thiazides |
| • Lithium-induced | Amiloride |
| Recurrent calcium stones in kidney due to hypercalciurea | Thiazides |
| Acute congestive glaucoma | Acetazolamide |
| Acute mountain sickness | Acetazolamide |
| Nocturnal enuresis | Desmopressin |
| SIADH | Fluid restriction + Hypertonic saline + Furosemide |

ANTIDIURETICS

| Class | Drugs |
|--|---|
| Antidiuretic hormone (ADH, Vasopressin) | Desmopressin, Lypressin, Terlipressin |
| Thiazide diuretics | Amiloride |
| Miscellaneous | Indomethacin, Chlorpropamide, Carbamazepine |

| | | |
|--|------------------|---|
| | Ertapenem | <ul style="list-style-type: none"> Similar to Meropenem, but has longer half-life, So, given parenterally once daily. |
|--|------------------|---|

OTHER INHIBITORS OF CELL WALL SYNTHESIS

| Drugs | Description |
|-----------------------|--|
| Vancomycin | <ul style="list-style-type: none"> Inhibits Cell wall synthesis Used in Penicillin-Resistant Staph. (MRSA), Strept. & Enterococcal infections. Side effects: Ototoxic, Nephrotoxic, Red man syndrome. |
| Teicoplanin | <ul style="list-style-type: none"> As vancomycin but given <i>once daily IM or IV</i> |
| Bacitracin | <ul style="list-style-type: none"> Inhibits cell wall synthesis Side effects: <i>Nephrotoxic</i> if used systemically |
| Fosfomycin | <ul style="list-style-type: none"> ↓se formation of N-acetyl muramic acid present in bacterial cell wall. Used as single oral 3-gm dose in non-complicated urinary tract infection in women. |
| 5-cyclosporine | <ul style="list-style-type: none"> 2nd line Anti-TB drug |

INHIBITORS OF CYTOPLASMIC MEMBRANE

| Drugs | Description |
|--------------------------------|---|
| Polymixin B | <ul style="list-style-type: none"> ↓Cytoplasmic membrane function → leakage of cell contents → <i>bactericidal</i> Affects mainly Gram -ve organisms esp. pseudomonas Not absorbed orally & nephrotoxic, so used ONLY locally |
| Daptomycin | <ul style="list-style-type: none"> It affects cell membrane permeability. Used IV in vancomycin resistant infections (VRSA). |
| Polypeptide antibiotics | <ul style="list-style-type: none"> Bacitracin (effective against Gram +ve) Polymixins (effective against Gram -ve) They are bactericidal & highly <i>nephrotoxic</i>, so, used <i>locally only</i>. |

MACROLIDE ANTIBIOTICS (TRICK - RACE S)

(Erythromycin - Clarithromycin - Azithromycin - Roxithromycin - Spiramycin)

| Drug | Mechanism of action | Uses | Adverse effects |
|---------------------|---|---|--|
| Erythromycin | They bind to 50 S ribosomal subunits → ↓ Translocation → ↓ Protein synthesis. | Corynebacterial diphtheria - Chlamydial infection Mycoplasma - Legionella & Bordetella pertussis. Chlamydial infection of urogenital tract during pregnancy | Epigastric pain Diarrhea (most common) Cholestatic jaundice Hypersensitivity reaction & skin rash |

SECTION

2

Human Anatomy and Physiology

→ **Complete Topic**

DESCRIPTOIN OF VARIOUS ORGANELLES PRESENT IN THE CELL

| Organelles | Description |
|-----------------------|---|
| Nucleus | <ul style="list-style-type: none"> • It is the largest structure present almost at the center of a cell. The nucleus contains. • Nucleus: it is a highly coiled filamentous structure present in the nucleus • Chromatin: these are fibrous threads present in the nucleus |
| Mitochondria | <ul style="list-style-type: none"> • the mitochondria are made up of proteins, phospholipids and some ribonucleic acid. • known as the “power house” of a cell because “Adenosine tri phosphate” (ATP) is produced in mitochondria. |
| Endoplasmic reticulum | <ul style="list-style-type: none"> • it is the most extensive cell organelle, present in the cytoplasm. Endoplasmic reticulum is of two types. • granular or rough ‘surfaced endoplasmic reticulum-contains ribosomes and are present at the site of protein synthesis. • Granular or smooth surfaced endoplasmic reticulum – they do not contain ribosomes. |
| Golgi apparatus | <ul style="list-style-type: none"> • it is situated between the nucleus and apex of the cell. • it is concerned with concentration of proteins prior to their secretion. • there are three types of golgi bodies namely cisternae, vesicles and vacuoles. |
| Lysosomes | <ul style="list-style-type: none"> • They are small, spherical or oval bodies surrounded by a single membrane. • They damaged intracellular organelles are also broken down and digested by the lysosomes. • Therefore, lysosomes are also called as “Suicidal bag of the cell”. |
| Centrosome | <ul style="list-style-type: none"> • It is small rod-shaped body found near the nucleus. • It plays an important role during cell division. |
| Microsomes | <ul style="list-style-type: none"> • They are extremely small, membrane bound, sac-like bodies present in the cytoplasm. • Microsomes originated from endoplasmic reticulum. • They can be separated by centrifuging a tissue homogenate at very high speed (10000 rpm). Microsomes contain ribosomes and granular matrix. |
| Ribosome | <ul style="list-style-type: none"> • Ribosomes are a cell structure that makes protein. Protein is needed for many cell functions such as repairing damage or directing chemical process. Ribosomes can be found floating within the cytoplasm or attached to the endoplasmic reticulum |
| Plasma membrane | <ul style="list-style-type: none"> • Barrier that separates the internal components of the cell from the extracellular materials and external environment is the cell membrane. It is the outer surface of the cell. It is selectively permeable to certain substances. It has osmotic properties. The thickness of cell membrane varies from 75 to 111 angstrom. |

FUNCTION OF CELL

| | |
|--------------------------------------|---|
| Ingestion and assimilation | <ul style="list-style-type: none"> Cell ingests chemical substances like amino acids from intercellular or interstitial fluid. |
| Growth and repair | <ul style="list-style-type: none"> The ingested and assimilated materials are used to synthesis new protoplasm. This leads to increase in size and growth of the cell. |
| Metabolism | <ul style="list-style-type: none"> Anabolism: in this process, the ingested and assimilated food material is used for growth and repair. Catabolism: in this process, the food materials is broken down to release energy for various functions of the cell. |
| Respiration | <ul style="list-style-type: none"> Transport of oxygen from lungs through blood to the tissues and removal of waste production like carbon dioxide, this is essential for the survival and functions of a cell. |
| Excretion | <ul style="list-style-type: none"> Cell eliminates waste production resulting from catabolism into interstitial fluid |
| Irritability and conductivity | <ul style="list-style-type: none"> The cell responds to any stimulus by contracting or the impulse is conducted as that occurs in a nerve cell. |
| Reproduction | <ul style="list-style-type: none"> After growing to an optimum size, the cell divides into daughter cells. Reproduction of cells occurs by two processes- "mitosis" and "meiosis". Mitosis occurs for replacing worn out the call or to replace those destroyed by disease. Meiosis is another kind of cell division occurring in the sex organs the testis and the ovary. |

CELL JUNCTION

| Junction type | Proteins | Functions | Examples |
|--------------------------|-----------|---|--|
| Tight junction | Occluding | <ol style="list-style-type: none"> Strength and stability to tissues Selective permeability Fencing function Maintenance of cell polarity Formation of blood brain barrier | <ol style="list-style-type: none"> Epithelial lining of intestinal mucosa and renal tubule Endothelium in capillary wall and choroids plexus |
| Gap junction | Connexins | <ol style="list-style-type: none"> Allows passages of small molecules, ions and chemical messengers Propagation of action potential | <ol style="list-style-type: none"> Epithelial lining Heart Intestine |
| Adherens junction | Cadherins | Cell to cell attachment | <ol style="list-style-type: none"> Epithelial lining Heart Epidermis |

| | |
|-------------------------|---|
| Visceral muscles | <ul style="list-style-type: none"> • Are located in the inner walls of hollow visceral organs of the body like the alimentary canal, reproductive tract, etc. • They do not exhibit any striation and smooth in appearance. • Hence, they are called smooth muscles. • they assist, for example, in the transportation of food through the digestive tract and gametes through the genital tract. |
| Cardiac muscles | <ul style="list-style-type: none"> • They muscle of heart. Many cardiac muscle cells assemble in a branching pattern to form a cardiac muscle. • Based on appearance, cardiac muscles are straited. • They are involuntary in nature system does not control their activities directly |

BONES IN HUMAN BODY

| HUMAN SKELETON - 206 bones | | | |
|--|------------------------|---|--|
| Axial 80 | | Appendicular-126 | |
| APPENDICULAR SKELETON - 126 BONES | | | |
| LIMB BONES - 120 | | GIRDLE BONES - 06 | |
| Fore limb Bones - 60 | Hind limb Bones - 60 | Pectoral Girdle - 4 | Pelvic Girdle - 2 |
| Humerus - 1 x 2 | Femur - 1 x 2 | Scapula - 1 x 2 | (is formed by 2 hip bones and each hip bone is formed by fusion of 3 hip bones ilium, ischium and pubis) |
| Radius - 1 x 2 | Patella - 1 x 2 | Clavicle - 1 x 2 | |
| Ulna - 1 x 2 | Tibia - 1 x 2 | | |
| Carpals - 8 x 2 | Fibula - 1 x 2 | | |
| Metacarpals - 5 x 2 | Tarsals - 7 x 2 | | |
| Phalanges - 14 x 2 | Metatarsals - 5 x 2 | | |
| | Phalanges - 14 x 2 | | |
| AXIAL SKELETON - 80 BONES | | | |
| SKULL SKELETON - 29 | | STERNUM - 01 | RIBS - 24 |
| SKULL BONES - 22 | | | VERTEBRAL COLUMN - 26 |
| Cranial - 8 | Facial - 14 | | True - 14 |
| Frontal - 1 | Maxilla - 2 | | False - 10 |
| Parietal - 2 | Palatine - 2 | | Cervical - 7 |
| Temporal - 2 | Zygomatic - 2 | | Thoracic - 12 |
| Occipital - 1 | Nasal - 2 | | Lumbar - 5 |
| Ethmoid - 1 | Lacrymal - 2 | | Sacral - 5 |
| Sphenoid - 1 | Inferior Turbinals - 2 | | Coccygeal - 4 |
| | Mandible - 1 | | |
| | Vomer - 1 | | |
| ASSOCIATED SKULL BONES - 07 | | | |
| Hyoid Bone - 1 | | Ear ossicles - 2x3 (Malleus. Incus. Stapes) | |

| | | |
|--|--|--|
| Pressure of blood is high and has a Pulse. | Presence of blood is low and has no pulse. | Pressure of blood falling and has no pulse detectable. |
| Blood flow rapid. | Blood flow slow. | Blood flow slow. |
| Low blood volume. | Much higher blood volume than capillaries or arteries. | High blood volume. |
| Blood oxygenated except in pulmonary artery. | Blood deoxygenated except in pulmonary vein. | Mixed oxygenated and deoxygenated blood. |

WAVES OF NORMAL ECG

| Wave/segment | From-to | Cause | Duration (second) |
|------------------|--|--|-------------------|
| 'P' wave | | Atrial depolarization | 0.1 |
| QRS' complex | Onset of 'Q' wave to the end of 'S' wave | Ventricular depolarization | 0.08-0.10 |
| 'T' wave | | Ventricular repolarization | 0.2 |
| 'P'-'R' interval | Onset of 'P' wave to onset of 'Q' wave | Atrial depolarization and conduction through AV node | 0.18 (0.12-0.2) |
| Q-'T' interval | Onset of 'Q' wave and end of 'T' wave | Electrical activity in ventricles | 0.4-0.42 |
| S-'T' segment | End of 'S' wave and onset of 'T' wave | Isoelectric | 0 08 |

LYMPHATIC SYSTEM

| Lymphoid organ | Lymphoid organ type | Function |
|------------------------|---------------------|---|
| Red bone marrow | Primary | To act as the major hematopoietic tissue, producing all the formed elements of blood including erythrocytes (red blood cells), leukocytes (white blood cells) and platelets (thrombocytes). |
| Thymus gland | Primary | Plays a key role in programming the immune system to recognize 'self' and provides a site for the maturation of T-lymphocytes |
| Spleen | Secondary | Helps trap foreign material and remove damaged and aged erythrocytes, while also acting as a reservoir for erythrocytes and platelets. |
| Lymph nodes | Secondary | Primarily filter lymph, trapping foreign material such as bacterial and viral particles |

SECTION

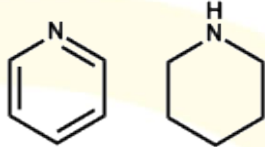
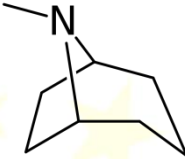
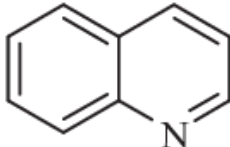
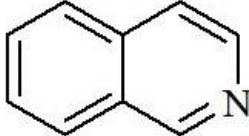
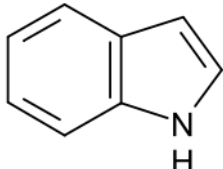
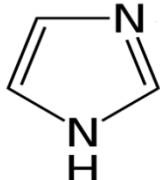
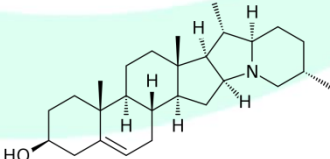
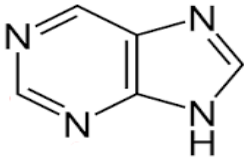
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Pharmacognosy

→ **Complete Topic**

Alkaloids

Classification of Alkaloids

| S. No. | Class | Structure | Example |
|--------|---------------------------------|--|---|
| 1. | Pyridine – Piperidine alkaloids |  | Tobacco, Areca, Lobelia |
| 2. | Tropane alkaloids |  | Belladonna, Datura, Hyoscyamus, Stramonium, Dubosia, Coca leaves, Ashwagandha |
| 3. | Quinoline alkaloids |  | Cinchona, Camptotheca |
| 4. | Isoquinoline alkaloids |  | Opium, Ipecac, Curare, Berberis |
| 5. | Indole alkaloids |  | Ergot, Nux vomica, Rauwolfia, Catharanthus, Physostigma |
| 6. | Imidazole alkaloids |  | Pilocarpus |
| 7. | Steroidal alkaloids |  | Veratrum, Kurchi |
| 8. | Alkaloidal amine | $\text{CH}-\text{CH}_2-\text{CH}_2-\text{NH}_2$ | Ephedra, Colchicum |
| 9. | Glycoalkaloids | - | Solanum |
| 10. | Purine alkaloids |  | Tea, coffee, Kola, Cocoa |

| | |
|---------|--|
| | <ul style="list-style-type: none"> ➤ Biological Source: - Chirata consists of the entire herb of <i>Swertia chirata</i> ➤ Family: - Gentianaceae ➤ Chirata contains chiritin, gentiopicrin and amarogentin. ➤ It also contains 2 alkaloids gentianine and gentiocrucine. |
| Quassia | <ul style="list-style-type: none"> ➤ Synonyms: - Bitter Wood, Jamaica Quassia, Bitter Ash. ➤ Biological Source: - Quassia is dried wood of the stem of <i>Aeschrion excels</i> (<i>Picroena excelsa</i> or <i>Picrasma excelsa</i>) ➤ Family: - Simarubaceae ➤ Quassia contains bitter amaroid compounds like quassin, isoquassin (picrasmin), neoquassin and 18-hydroxy quassin. |
| Kalmegh | <ul style="list-style-type: none"> ➤ Synonyms: - Andrographis, King of bitters, Kiryet (Hindi). ➤ Biological Source: - leaves or entire aerial part of <i>Andrographis paniculata</i> ➤ Family: - Acanthaceae ➤ Chemical Constituents: - kalmeghin |

Volatile Oils

Classification of volatile oils

Volatile oils are classified on the basis of functional groups present

| Groups | Drugs |
|-----------------|---|
| Hydrocarbons | Turpentine oil |
| Alcohol | Peppermint oil, Pudina, Sandalwood oil, etc. |
| Aldehydes | Cymbopogon sp., Lemongrass oil, Cinnamon, Cassia, and Saffron |
| Ketones | Camphor, Caraway and Dill, Jatamansi, Fennel, etc. |
| Phenols | Clove, Ajowan, Tulsi, etc. |
| Phenolic ethers | Nutmeg, Calamus, etc. |
| Oxides | Eucalyptus, Cardamom, and Chenopodium oil |
| Esters | Valerian, Rosemary oil, Garlic, Gaultheria oil, etc. |

Classification of terpenoids

- Terpenes usually have **5n carbon atoms** (n is an integer) and are subdivided as follows

| S. No. | Class | No. Of isoprene units (C ₅ H ₈) _n | Molecular formula | Examples |
|--------|------------------------------|---|---------------------------------|---|
| 1. | Hemiterpene or isoprene | 1 | C ₅ H ₈ | Isoprene |
| 2. | Monoterpenes or terpenes | 2 | C ₁₀ H ₁₆ | Cital, Camphor, Menthol, Limonine, α- Pinene, Nerol |
| 3. | Sesquiterpenes | 3 | C ₁₅ H ₂₄ | Farnesol, Zingiberene, Acorone, Eremophilone |
| 4. | Diterpenes | 4 | C ₂₀ H ₃₂ | Abietic acid, Phytol |
| 5. | Triterpenes | 6 | C ₃₀ H ₄₈ | Amyrin, Squalene |
| 6. | Tetraterpenes or carotenoids | 8 | C ₄₀ H ₆₄ | Caratenoid |

| | |
|----------|---|
| | <ul style="list-style-type: none"> ➤ Family: - Bovidae |
| Casein | <ul style="list-style-type: none"> ➤ Casein is a proteolytic enzyme obtained from the stomachs of calves. ➤ It is extracted from the proteins of the milk; in the milk, casein is structured in voluminous globules. ➤ The casein content of milk represents about 80% of milk proteins. ➤ The principal casein fractions are alpha (s1) and alpha (s2)-caseins, β-casein and κ-casein. The distinguishing property of all casein is their low solubility at pH 4.6. ➤ The isoelectric point of casein is 4.6. |
| Collagen | <ul style="list-style-type: none"> ➤ Synonym: -Ossein. ➤ Biological Source: - It is the protein which consists of major portion of white fibres in connective tissues of the animal body specifically, from the tendons, skin, bones, and teeth. |
| Ficin | <ul style="list-style-type: none"> ➤ Ficin is found in the latex of the plants of the Genus Ficus. ➤ Commercial ficin is purified from the latex of the fig tree, <i>Ficus glabatra</i> or <i>Ficus carica</i>. |

Lipids

Saturated fatty acids

| FATTY ACID | NO. OF CARBON | FATTY ACID | NO. OF CARBON |
|---------------|---------------|---------------|---------------|
| Butyric acid | 4 | Lauric acid | 12 |
| Caproic acid | 6 | Myristic acid | 14 |
| Caprylic acid | 8 | Palmatic acid | 16 |
| Caric acid | 10 | Stearic acid | 18 |

Unsaturated fatty acids

| Name and Source | Structure |
|---|---|
| Palmitoleic acid (Cotton seed oil) | $\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}(\text{CH}_2)_7\text{CO}_2\text{H}$ |
| Oleic acid (Safflower oil) | $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{CO}_2\text{H}$ |
| Linoleic acid (Sesame oil, Sunflower oil) | $\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{CO}_2\text{H}$ |
| Linolenic acid (Linseed, soyabean oil) | $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{CO}_2\text{H}$ |
| Arachidonic acid | $\text{CH}_3(\text{CH}_2)_4(\text{CH}=\text{CHCH}_2)_4(\text{CH}_2)_2\text{CO}_2\text{H}$ |

Synonyms of Lipid

| S.NO. | Plants | Synonyms |
|-------|-----------------|------------------------------|
| 1. | Arachis oil | Peanut oil |
| 2. | Carnuba wax | Brazil wax |
| 3. | Castor oil | Ricinous oil, Cold drown oil |
| 4. | Chaulmoogra oil | Hydrocarpus oil |
| 5. | Cocoa-butter | Theobroma oil |
| 6. | Kokum butter | Goa butter |
| 7. | Neem oil | Margosa oil |
| 8. | Sesame | Gingelly oil |
| 9. | Wool fat | Lanolin |
| 10. | Lord | Adep |
| 11. | Bees wax | Yellow bees wax |

Biosynthesis precursor of plants

Alkaloids

| S.NO. | TYPES OF ALKALOIDS | EXAMPLE | AMINO ACID PRECURSOR |
|-------|---------------------------------|---|----------------------|
| 1. | Tropane alkaloids | Hygrine, methylecogine cocain, Hyoscine, Hyoscyamine, and Atropine | Ornithine |
| 2. | Pyrrolizidine | Lycospanimne and Senecionine | Lysine |
| 3. | Piperidine | Pelletriene, Sedamine, and Piperine | |
| 4. | Quinolizidine | Lupinine and Sprteine | |
| 5. | Indolizidine | Swainsonine | |
| 6. | Pyridine | Nicotine, Anabesine, Arecoline | Nicotinic acid |
| 7. | Tetrahydroisoquinolin | Papaverine, Narceine Tubocurarine | Tyrosine |
| 8. | Benzyltetrahydroisoqu noline | Morphine, Codeine, thebaine, | |
| 9. | Phenthyloisoquinoline | Colchicine | |
| 10. | Terpenoid tetrahydroisoquinolin | Emetine, cephaline | |
| 11. | Indole | Psilocaine, Ajmalicine, Yohimbine, Reserpine, Strychine, Brucine, Catharanthine | Tryptophan |
| 12. | Pyroloindole | Physostigmine, Ergometrine, Ergotamine | |
| 13. | Quinoline | Quinine, Quinidine, Chinchonine, Chinchonidine and Camptothecin | |
| 14. | Quinazoline | Vasicine | |
| 15. | Imidazole | Pilocarpine | Anthranilic acid |
| 16. | Amine | Ephedrine and pseudoephedrine | Histidine |
| 17. | Terpenoids | Aconitine | Phenylalanine |
| 18. | Steroids | Solasodine | Monoterpenes |
| 19. | Purine | Caffeine, Theobromine and Theophylline | Steroids |
| | | | Purine |

Glycosides

| CLASS | PATHWAY | PRECURSOR | EXAMPLE |
|---------------------|--------------------|------------------------------|---------------------------------|
| Anthraquinoline | Acetate | Polykedite | Rhein, Aloe-emodin, Emodine |
| Cardioactive sterol | Acetate mevalonate | Squalene | Digotoxigenine, Digoxigenine |
| Saponins | Acetate mevalonate | Squalene | Diogenin |
| Flavonoids | Shikimic acid | Cinnamoyl - Coa | Quecetin, Hesperidin, Kaemferol |
| Cyanogenetic | Shikimic acid | Phenylalanine and tyrosine | Amygdalin and prunasin |
| Coumarin | Shikimic acid | Cinnamic acid | Psoralen, Khellin |
| Isothiocyanate | Amino acid | Methionine and Phenylalanine | Sinigrin and Sinablin |