



<http://www.pharmaxchange.info>

BASIC CONCEPTS OF PHARMACOLOGY

SUNALI MEHTA

Pharmacology: It is the science of drugs and its physical and chemical properties and their affect on the body and how they interact with other substances.

Pharmacology can be divided into 3 sections:

Pharmacokinetics: deals with the absorption, distribution, biotransformation and excretion of the drugs and its metabolites from the body.

Pharmacodynamics: deals with the biochemical and physiological effect of the drug as well as its mechanism of action.

Pharmacogenetics: is the study of the role of genes in determining the drug metabolism.

Drug is anything chemical that enters the body and has some physiological effect on the body. It is not necessarily a compound that provides a therapeutic effect.

Drugs can be used for treatment as follows:

Cure and hence taken only for a short period of time e.g. antibiotics

Control and needs to be taken long term e.g. Insulin

Alleviate symptoms and these do not cure e.g. analgesics.

Naming of a drug:

Chemical Name: Derived from the drugs chemical structure and used very rarely.

Generic Name: is the official simplified chemical name of a drug and describes the most active constituent of the medicine.

Brand Name: is the commercial name under which the drugs are sold. Patent laws apply and can be used only by the company that has registered it.

Group Name: describes the drug class to which the drug belongs and this name also reflects the pharmacological action of the drugs or the therapeutic area of the drug action

Side effects and adverse effects of the drugs:

Side effects are the physiological effects that are not related to the desired drug effect. They are predictable. They are unavoidable since the action of the drug may not be highly targeted and influence other organs or tissue parts.

Adverse reaction or adverse effects: are more severe than the side effects and is an undesirable effect of the drug that can range from mild to severe toxicity and hypersensitivity reaction and anaphylaxis. All such reactions should be documented and reported for further analysis. In New Zealand these are documented with the **Centre of Adverse Reaction Monitoring (**CARM**).**

Drug Action: A drug is a molecule that has a specific action on the body that is independent of its source – synthetic or natural.

Therapeutic dose is the smallest amount that will elicit a response and the largest dose that can be tolerated without excessive side effects.

Therapeutic Window: is the gap between the dose needed to produce its effect in 50% of the population and that needed for the undesired effect.

Therapeutic Index: estimates the margin of safety of the drug.

Narrow: means a narrow margin of safety e.g. Gentamicin, digoxin

Broad: means a wide margin of safety. E.g

Therapeutic drug monitoring is necessary for drugs with a narrow therapeutic index and the reason for this is that the gap between the amount of drug required for a therapeutic effect and the amount of drug that causes unwanted effects is very small. Hence when these drugs are given from one patient to another their effect may vary and hence needs to be monitored each time to ensure that the drug is having a therapeutic effect and not a adverse reaction. Drug monitoring may vary from person to person. When a person has just started the medicine drug monitoring will be more rigorous.

Prescription drugs: are medicines that need to be prescribed by an authorized person. Midwives, nurses, pharmacists, physiotherapists, doctors.

Over the counter drugs: are available to general public in the pharmacy and the supermarkets.

Pharmacy – only drugs: can be sold in a community or hospital pharmacy and in an isolated shop that is licensed to sell such drugs. Different to restricted drugs as these medicines can be sold without prescription, but should be sold only by a registered pharmacist and should be recorded.

Tolerance: decreased response to the drug and it is when the dose of the drug should be increased to achieve the same effect.

Dependence: is when the patient needs the drug to function normally : two types:

Physical dependence: develops with an ongoing exposure e.g. cancer patient

Psychological dependence: is when the persons mind says that “ I need the drug” e.g. cup of coffee.

Withdrawal: occurs when no longer the drug is given to a patient and the side effects of not getting the drug are visible.

The Five Rights of Drug Administration:

Right Drug

Right Dose

Right Client

Right Time

Right Route.

Formulation and Administration routes of Drugs:

Solid drugs are administered in the form of tablets. The tablet is disc shaped and is made by compressing a granulated powder in a die of the suitable machinery. It is made up of inert filler material since the drug maybe required only in small quantities. To help the tablet disintegrate in the GI tract it is coated with a substance like starch which swells up when in contact with fluid, such substances are called excipients. Binding agent to hold the tablet together and finally lubricating material to prevent the tablet from sticking during manufacture. They can be sugar coated or film coated. Some are given as chewable tablets and flavourings can be added to this. These are called Dragees.

Enteric coated tablets: these tablets are coated with a material that does not disintegrate in the acidic medium of the stomach but disintegrates in the alkali medium of the intestine. These have EC written on their cover and it is essential that these drugs are not crushed and swallowed. Now some of these preparation are made in which small portions of the drugs are enteric coated into tiny balls and are enclosed in a capsule. This can be opened and sprinkled on a suitable medium and then swallowed.

Capsules come in two forms: Hard and soft. Hard contains the drug in solid form and the soft contains the drug either in liquid or semi – solid form. The soft capsules are useful for the drugs that are hard to dissolve in water these are then dissolved in non – toxic solution such as propylene or glycol and can be easily absorbed in the GI tract.

Sustained release preparation: Useful of drugs that have a short half life and hence such drugs are formulated to be released slowly into the digestive tract. Also called slow release or retard release. This is also done to improve the compliance to the drug.

1. the drug is embedded in a matrix of relatively inert material such that the drug release is slow.
2. The drug can be prepared in layered tablets such that the each layer of drug is coated by some inert material and hence once the layer disintegrates the drug is released and till the next layer is not disintegrated there is no further release of drugs.
3. The drug can be made in the form of pellets which are coated by different thickness of the inert material and the one with the thinnest coating would disintegrate the fastest and the other will not. These pellets are then filled in capsules also called spansules and tablets called durules.

Controlled release tablet: since the amount of drug that would be disintegrated would depend on the composition of the GI tract of the individual and hence there would not be much uniformity there is a new technique called the controlled release tablets. In this case the drug is covered with a semi permeable membrane and hole is punctured through this membrane with the help of a laser. Once the tablet enters the GI tract the water seeps inside thru the hole and the tablet swells and due to the difference in the osmotic pressure the drug is released. This method is preferred since the amount of drug released is same for most of the people since it is not pH dependant.

These drugs would have CR or SR written on the cover.

Oral Liquid preparation: Such preparations are made when it is difficult to swallow the medicines. Flavourings can be added. But it should not be that flavour is given a lot of importance since then drug abuse is possible. Sugar is added in some cases but mostly sorbitol (sugar alcohols) is now used and it is good since it acts as a osmotic laxative and can prevent drug abuse. When the drug is insufficiently soluble in water then it is dissolved in alcohol such a drug is called exilirs. Incases where the drug is used as a solid and alcohol is not used for dissolving then such solutions are called suspension and when the liquid which is not soluble is used then it is called emulsion. Such drugs should be well shaken before use.

Topical preparation: the application of a drug to an area of the body for direct treatment is called topical application and is not restricted to the skin and hair but can be used in the mouth and entire GI tract during operations.

1. Drops: Eye and nose drops are made isotonic to avoid pain and discomfort on application. The eye drops are either aqueous or oily suspensions to be put into the eye.
The nasal drops are aqueous since oily solution can hinder the ciliary action of the mucosa and also enter the trachea and lead to aspiration pneumonitis. Ear drops are oily solutions that can adhere to the aural cavity.
2. Creams and Ointments: mainly used for skin treatment. Creams have an aqueous base such that the water evaporates quickly and the drug remains on the surface. It remains on the superficial layer of the skin and very little is absorbed into the systemic circulation where it can have such an action.
Ointments are lipid base. When they are applied on the body they shut off the skin from air and the sweating still occurs as a result of which the skin is softened and there is more penetration of the drug into the tissue. Absorption can be significant.
3. Pastes: Pastes have powder and are water repellent and hence help in protecting the skin from moisture.
4. Gels and Lotions: are alcoholic based and useful in application where there is hair. Since the evaporation is fast very little of the drug penetrates.

Sublingual and Buccal Administration:

Utilizes the mucosa of the mouth as an absorptive medium. This is useful when the drug is active in very low concentration in the blood. When the drug is administered like this it directly enters the blood stream and has a systemic action where required. It is also useful to bypass the hepatic first pass metabolism. This method avoids the mixing of the drug with food and other gastric juices which may impede absorption.

Sublingual is under the tongue and is allowed to dissolve e.g. glyceryl trinitrate

Buccal is between the cheek and gum and is allowed to dissolve. E.g. oxytocin

Buccal tablets are too large to be administered sublingually

Intranasal administration: it is mainly a topical application where the drug is absorbed from the epithelium of the nasal tract. Mainly used to relieve nasal congestion but can also be used for drugs that are destroyed by the enzymatic action when taken in by the mouth.

Transdermal Administration: The skin can also be used for direct application and absorption of the drug but the drug is very slowly absorbed and in very less quantity and this is due to the presence of keratin in the cells of the skin. Therefore drugs that are needed in very small quantities and for long period of time are administered in this way. These include transdermal patches and gels and spray.

Rectal Administration:

Suppositories: are used for drugs being administered through the rectum. The drug is absorbed by the rectal mucosa and directly into the blood stream. Advantages: when a patient is unconscious then oral administration is difficult and hence this is easier.

Nausea, clients with difficulty in swallowing, to avoid the hepatic first pass, where it is difficult to find a vein.

Disadvantage: anal or rectal irritation, client education, risk of perforation of the rectum, need to be refrigerated since they melt with body heat

Enemas: are also preparations for rectal administration but are liquid. These can be used for topical or systemic treatment and also for bowel movement. Topical and systemic applications the solution is hypotonic such that fluid will be taken up by the body along with the active ingredient. In case of bowel motion the solution is hypertonic to cause an outward flow of water from the body into the distal portion of the digestive system.

Vaginal Administration: are also called pessaries. Topical treatment. The drug should coat all the vaginal mucosa and for this the drug should be entered as high as possible into the vagina.

Parental Drug Administration: any method of drug administration that avoids the GI tract is called parental administration. Drugs can be inserted anywhere with the help of injections.

Intradermal administration: drug is inserted into the dermis. Rarely used since absorption is slow and only small quantities can be given. E.g. Local Anesthesia

Subcutaneous injection: Slow drug absorption but mainly for drugs that cannot be given through the mouth for e.g. Insulin. This method is used when other modes are harmful. The effect of the injection can be decreased by adding adrenaline as this would cause vasoconstriction and slow absorption of the drug. If another drug is added like hyaluronidase it will enable the drug to be absorbed more quickly since it will destroy the tissue cement the hyaluronic acid.

Intramuscular Injections: The skeletal system is highly vascular and hence drugs with low molecular weight can easily pass through by direct diffusion into the blood stream thru the capillary walls. Mainly lipid soluble drugs are easily absorbed. Lipophobic drugs are absorbed into the lymphatic system. When mixed with oil the drug disintegrates slowly and may take several weeks for action called the depot injections. Diadv: is the damage to the nerves and hence care has to be taken while giving such injections.

Intravenous Injections: this administration avoids the process of absorption and hence very fast action can be achieved.

Nebuliser and Inhaler administration: administer to the lower respiratory passage of the body.

Adverse Drug Reactions

Two types:

Occur with the normal pharmacological profile of the drug: Type A reactions: Predictable effect. In this case the reason is known and the conditions can be reversed by reducing the dose or switching over to another medicine.

Not related to the profile of the drug: Type B reactions: Non – predictable effect: is mainly due to genetic differences in the metabolism of the drug, immunologically mediated effects and the main reason is that the outcome can be fatal since the mechanism for the adverse reaction is not known.

Common adverse effects of drugs:

Respiratory depression: is a pattern of regular respirations with a rate of less than 12 breaths a minute. The respiratory centers regulate the breathing in coordination with the medulla and pons. When there is a reduced cerebral perfusion to activate the neurons of the respiratory center or when there is a change in the levels of arterial carbon dioxide and they trigger the chemoreceptors, or when there is a reduced effectiveness in changing the levels of carbon dioxide by the respiratory neurone there can be respiratory depression. Mainly caused by CNS depressants.

Anaphylactic Shock: is an acute dramatic reaction characterized by respiratory depression, angio – oedema, cardiovascular collapse, vomiting and urticaria. Mainly when there is an allergic reaction to the drug for e.g. penicillin.

Dizziness: is a sensation of imbalance, associated with weakness, confusion, blurred or double vision. These episodes are usually short. It is mainly due to irregular blood flow to the brain and spinal cord. Cause: CNS depressants, narcotics etc

Constipation: Involves infrequent and difficult bowel movements. It is the ANS which is responsible for controlling the bowel movements. It may lead to lack of appetite and abdominal discomfort. Cause: Narcotics, analgesics, antacids, too much laxative.

Hypertension: Blood pressure relates to the force exerted on the blood vessels and is affected by the cardiac output, peripheral vascular resistance and blood volume. Raised bp is referred to as hypertension and in this case the arterial walls thicken, become less elastic and resistant to blood flow. Cause: sympathomimetics, corticosteroids, oral contraceptives, MAOI, CNS stimulants

Hypotension: is decreased Bp to oxygenate the body tissues. Can occur due to vasodilation, dehydration and severe bleeding. Cause: calcium channel blockers, diuretics, antihypertensives, general anesthesia.

Oral Candidiasis: it is a mild superficial fungal infection caused by the candida species in the mouth. These bacteria are found in the normal flora of the mouth and when the drug alters the balance of this flora it leads to infection and can result in blue – white patches on the tongue, mouth and pharynx. Cause : antibiotics

Rash: Type of skin eruption. Cause: antibiotics

Dry Mouth: decreased salivation, involves the decreased production of saliva resulting from mouth breathing. Cause: antimuscarinics, narcotics and excessive irradiation of the mouth or face.

Nausea: involves profound aversion of food or an impeding desire to vomit. The medication tends to produce this by stimulating the vomiting centers in the medulla oblongata or by irritating the GI tract. Cause: narcotics, analgesics

Drowsiness and sedation: decreased level of consciousness follows after the use of medication that depresses the CNS.

Fever: or pyrexia: arise from any medical condition that can affect the body system. Cause: hypersensitive reactions, chemotherapy, drugs that impair sweating.

Photophobia: is an abnormal sensitivity to light results from ocular dilation and reduction in aqueous humour drainage. Cause: mydriatics, ophthalmic viral drugs

Stomatitis: characterized by recurrent, painful ulceration of the oral mucosa. Can be a cause of an allergic reaction. Cause: Cytotoxic drugs, radiation therapy.

Diarrhoea: is an increase in the frequency and fluidity of the bowel movement. Cause: antibiotics, antacids, laxative abuse.

Angogenital candidiasis; mild fungal infection caused by the candida species in the vaginal, anal or penile areas. Cause: Oral contraceptives, other oestrogen containing preparations.

Vomiting: is the expulsion of the gastric contents by the mouth as a result of coordinated contraction of abdominal muscles and reverse oesophageal peristalsis.

Blistering: is a small thin walled raised vesicle containing clear, serous, purulent or bloody fluid. Can result due to allergy reaction. Antibiotics, cytotoxic drugs.

Photosensitivity: is an increased reactivity to sunlight: anticancer drugs, phenothiazine

Postural hypertension: is an abnormally low bp that occurs when an individual takes a standing position. It is often associated with medication that block the alpha – adenoreceptors. Cause: sympatholytics, phenothiazines antihypertensives.