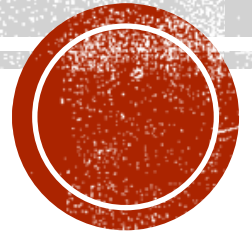
NARAYANA
COLLEGE OF NURSING

ROUTES OF DRUG ADMINISTRATION



BY

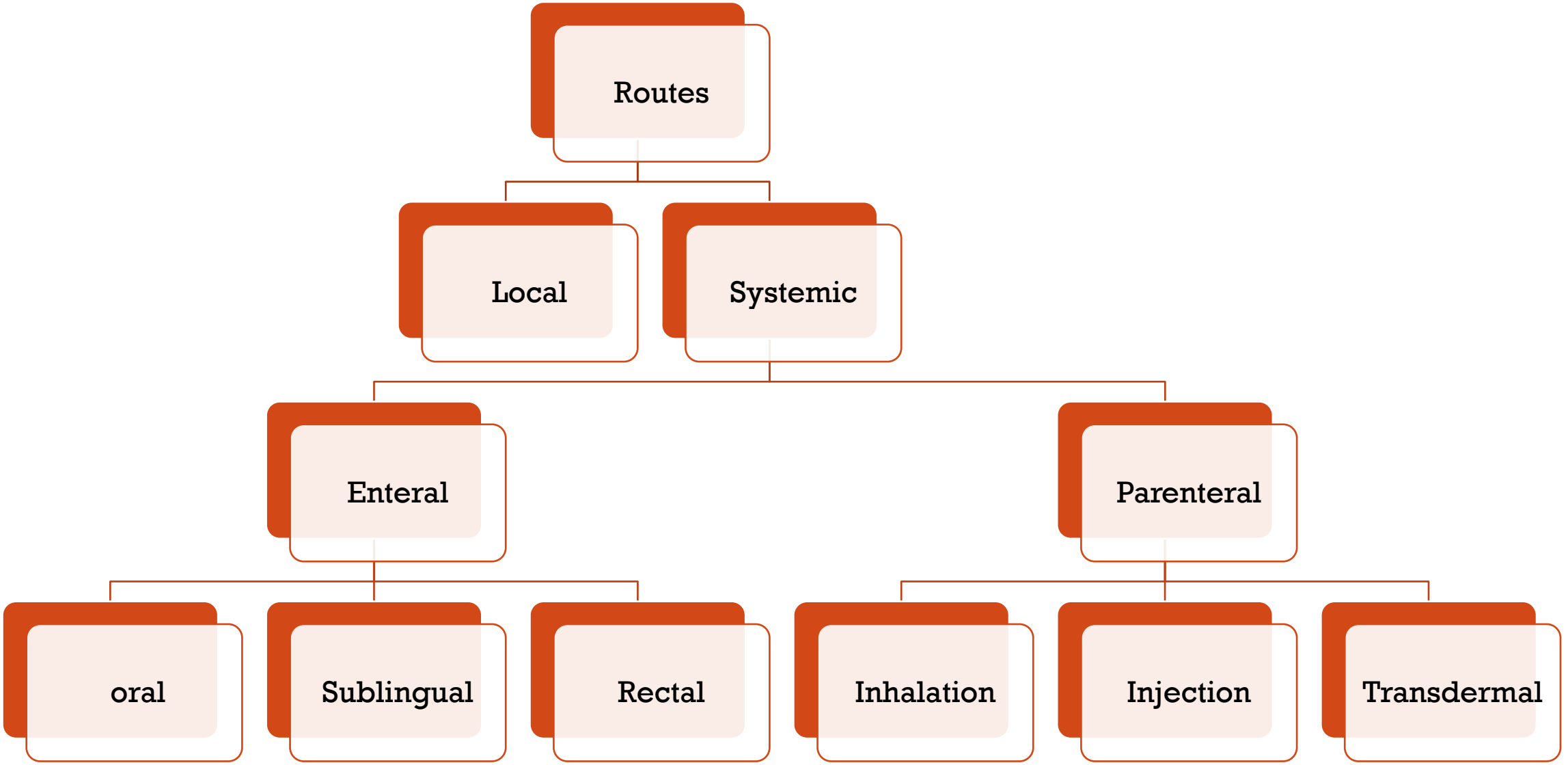
***Dr. Anjani Devi**. Nelavala M.Sc. Nursing, Ph.D. .M.B.A*

Assoc. Professor

Department of Mental Health Nursing cum HOD of Nursing Research

THE SELECTION OF ROUTES OF DRUG ADMINISTRATION

- Characteristics of the drug
- Emergency / routine use
- Condition of the patient (unconscious, vomiting, diarrhea)
- Age
- Associated diseases
- Sometimes patient and doctor's choice


Routes
Local
Systemic
Enteral
Parenteral
oral
Sublingual
Rectal
Inhalation
Injection
Transdermal

LOCAL ROUTES

1. **Topical :** drug is applied to the skin or mucous membrane at various sites for localized action

- Oral cavity :
  - As a suspension : eg; Nystatin
  - As a troche : eg; Clotrimazole (for candidiasis)
  - As a cream : eg; Acyclovir (for herpes labialis)
  - As ointment & jelly: eg; 5% Lignocaine HCL (for topical anaesthesia)
  - As a spray : eg; 10% Lignocaine HCL (for topical anaesthesia)

- GI tract : a tablet which is not absorbed eg: neomycin (for sterilization of gut before surgery)
- Rectum and anal canal :
  - As a enema
    - Evacuant enema (eg; Soap water)
    - Retention enema (methylprednisolone)
- As a suppository (eg: Bisacodyl)
- Eye, Ear, Nose : (Drops, Ointments, Sprays etc.
- Bronchi: (eg; Salbutamol)

2. Certain deeper areas can be reached by using syringes and needles. (eg; infiltration anaesthesia with local anesthetics)

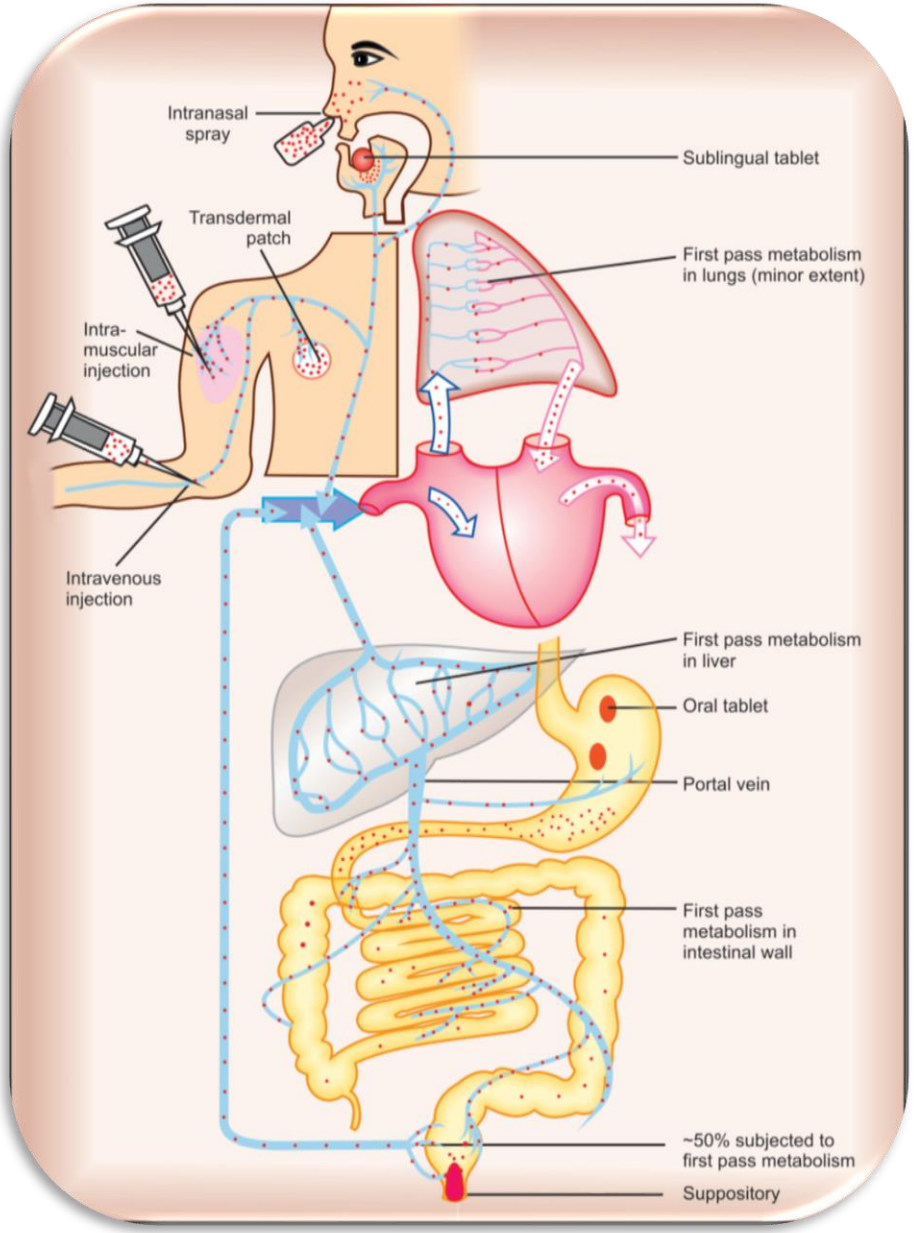
SYSTEMIC ROUTES

Enteral routes

- Oral, Sublingual, Rectal

Parenteral routes

- Inhalation
- Injections
  - intradermal
  - Subcutaneous
  - Intramuscular
  - Intravenous
  - Intra arterial
  - Intrathecal
  - Intra articular
- Transdermal route



ORAL

Advantage

- Safer
- Cheaper
- Painless
- Convenient for repeated and prolonged use
- Can be self administered

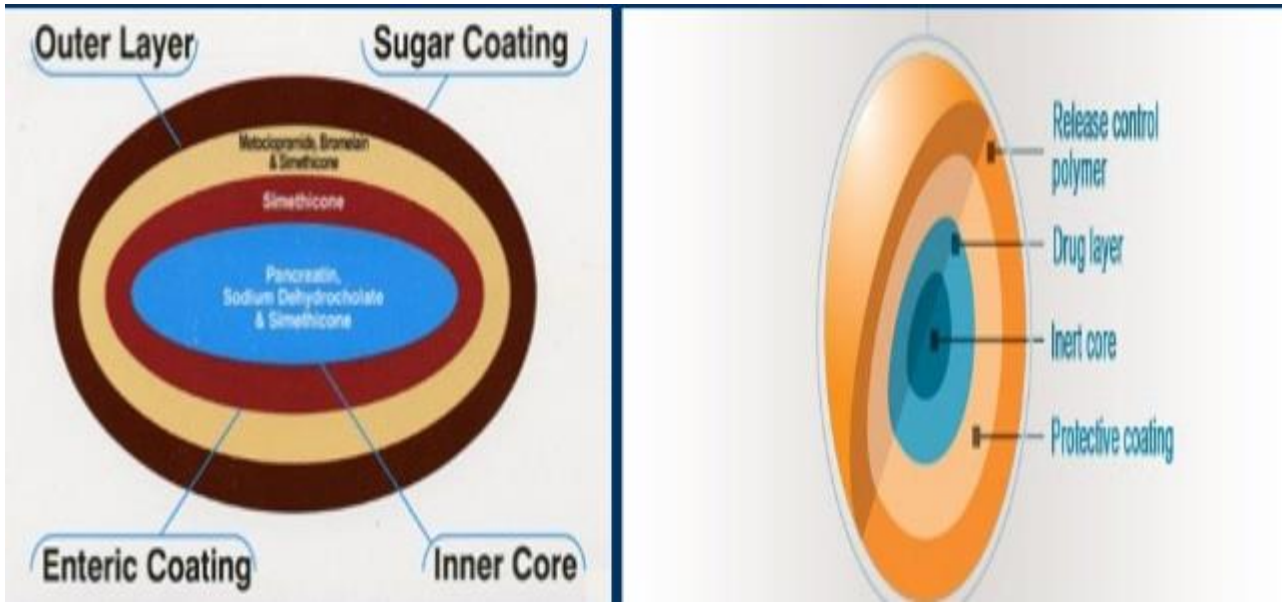
Disadvantage

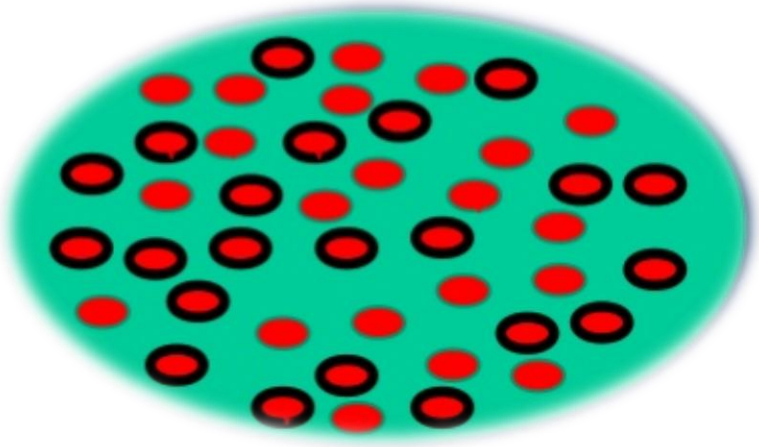
- Slow onset of action, hence not used in emergency

It is not suitable for

- Unpalatable an highly irritant drugs
- Unabsorbed drug (Aminoglycosides)
- Destroy by digestive juice (insulin)
- Extensive first pass metabolism (lignocaine)
- Unconscious patients
- Uncooperative and unreliable patients
- Patients with severe vomiting and diarrhoea

- **Enteric coted tablets & capsules:** coting is made of cellulose, acetate, etc. it may be used for prevent gastric irritation, protect the drug form gastric acid and retard the absorption of the drug, thereby prolonging its duration of action.





- **Sustained or time released preparations :** it consists of drug particles, which have different coting that dissolve different intervals of time. (eg; Nifedipine)

SUBLINGUAL ROUTE

THE PREPARATION IS KEPT UNDER THE TONGUE (EG; NITROGLYCERIN)

Advantage

- Quick onset of action
- Action can be terminated by spitting out the tablet
- Bypasses the first pass metabolism
- Self administration is po

Disadvantage

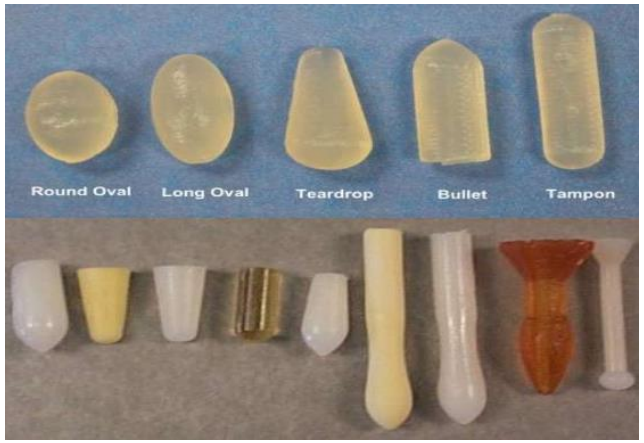
It is not suitable for:

- Irritant and lipid-insoluble drugs
- Dugs with bad smell and taste
- Children

RECTAL ROUTE

- Drugs can be given in the from of solids or liquids

1. Suppositories : They an be used for local as well as systemic effect, eg; Indomethacin for rheumatoid arthritis



2. Enema : Retention enema can be used for local effect as well as systemic effect. The drug is absorbed through rectal mucous membrane and produces systemic effect, eg; Diazepam for status epilepticus in children

PARENTERAL ROUTES

ROUTES OF ADMINISTRATION OTHER THAN ENTERAL ROUTE ARE CALLED PARENTERAL ROUTES.

Advantages

- Rapid onset of action, suitable for emergency

It is useful in

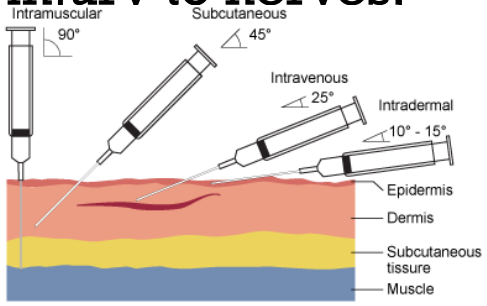
- Unconscious patients
- Uncooperative and unreliable patients
- Patients with severe vomiting and diarrhea

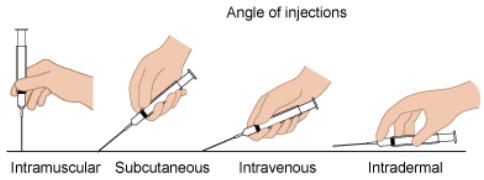
It is suitable for

- Irritant drugs
- Drug with high first pass metabolism
- Drugs not absorbed orally
- Drugs destroyed by digestive juices

Disadvantages

- Require sterilization and aseptic conditions
- Are expensive
- Require invasive techniques, which are painful
- Cannot be usually self-administered
- Can cause local tissue injury to nerves. vessels, etc.





INHALATION

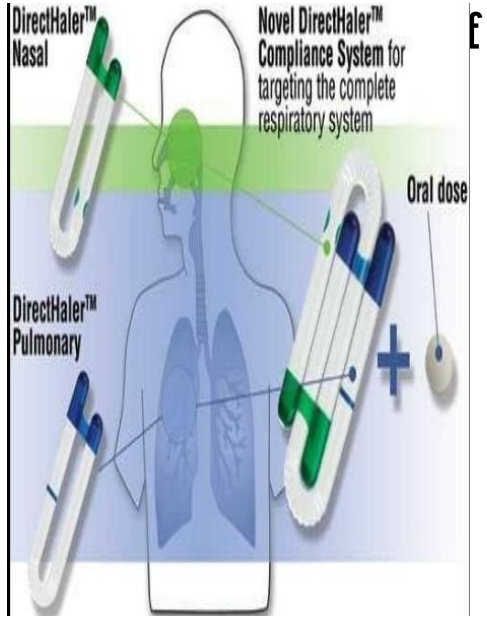
VOLATILE LIQUIDS AND GASES ARE GIVEN BY INHALATION FOR SYSTEMIC, EG; GENERAL ANAESTHETICS.

Advantages

- Quick onset of action
- Dose required is very less, so systemic toxicity is minimized
- f drug can be regulated

Disadvantages

- Local irritation may cause increased respiratory secretions and bronchospasm.



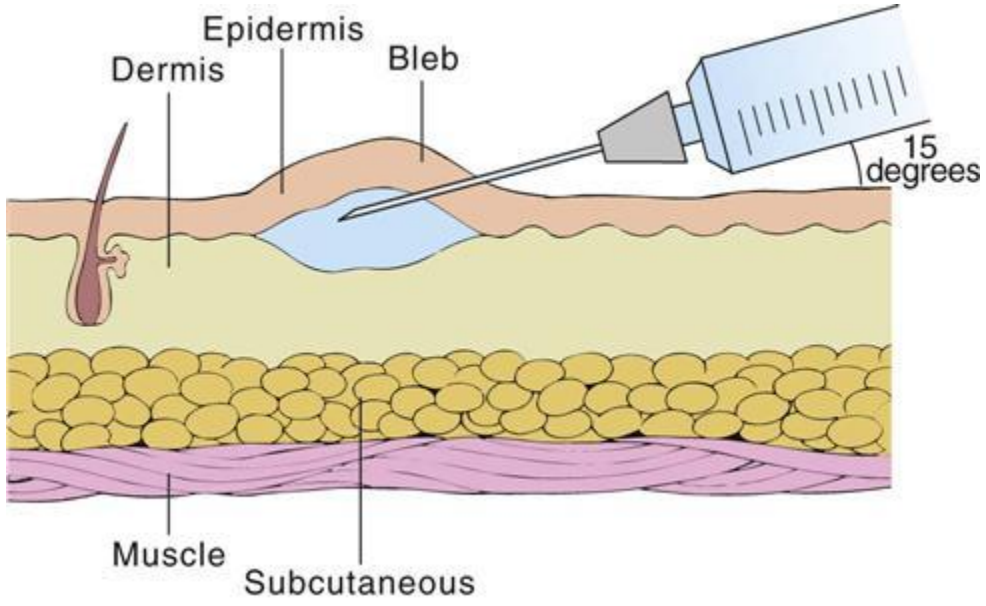
Metered dose inhaler

Dry powder inhaler

INJECTIONS

Intradermal route : the drug is injected into the layers of the skin, eg; BCG vaccination, drug sensitivity tests, etc..

- It is painful and only a small amount of the drug can be administered



SUBCUTANEOUS ROUTE (S.C)

INJECTED IN TO SUBCUTANEOUS TISSUE, EG; ADRENALIN, INSULIN

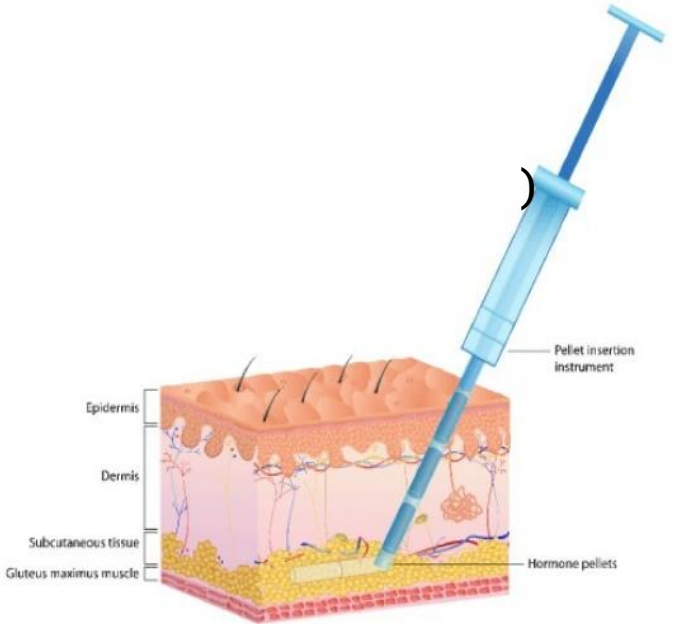
Advantages

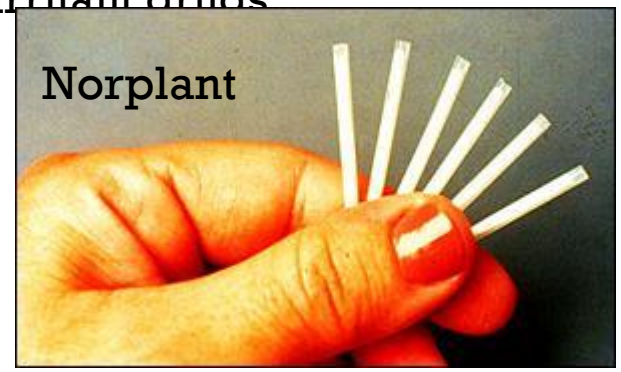
- Self administration is possible (eg; insulin)
- Depot preparations can b inserted into th subcutaneous tissue (Norplant fc contraception)

Disadvantages

- It suitable only for non irritant drugs

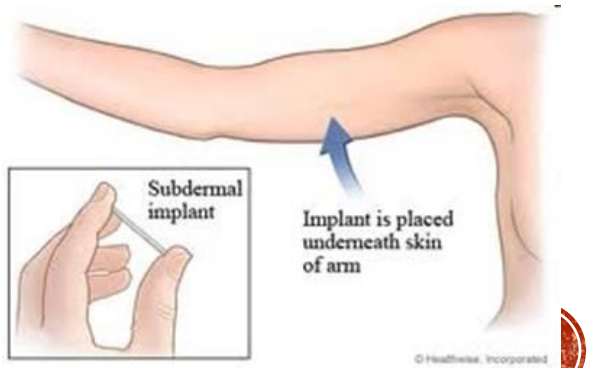
)





Some special forms

- Dermojet
- Pellet implantation (Testosterone)
- Sialistic (nonbiodegradable) and biodegradable implants (eg; Norplant)



INTRAMUSCULAR ROUTE

DRUGS INJECTED INTO LARGE MUSCLES SUCH AS DELTOID, GLUTEUS MAXIMUS, LATERAL ASPECT OF THIGH IN CHILDREN, A VOLUME 5-10 ML CAN BE GIVEN AT A TIME.

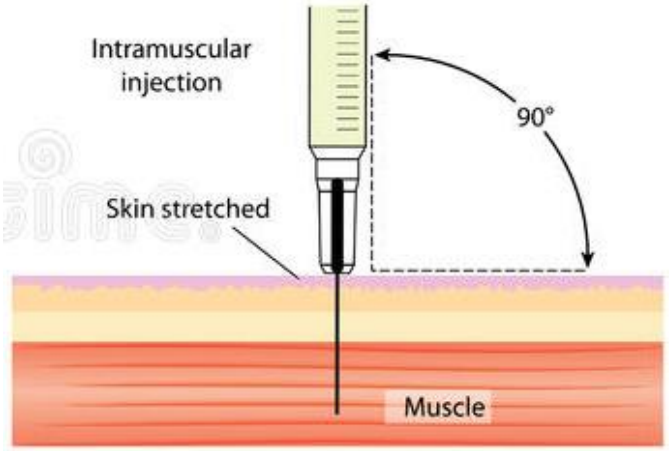
Advantages

- Absorption is more rapid as compared to oral
- Mild irritants, depot injections, soluble substance and suspensions can be given by the r

Disadvantages

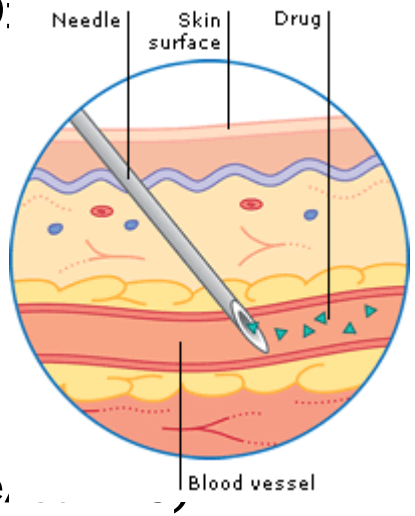
- Aseptic conditions are needed
- Painful may cause abscess
- Self-administration is not possible

y may be injury to the nerves



INTRAVENOUS ROUTE

- Drugs are injected directly into the blood stream through a vein. D
  administrated as;



1. Bolus: Single, relatively large dose of drug injected rapidly or solely as
   unit in to a vein.
2. Slow intravenous injections: eg; Morphine
3. Intravenous infusion (adding the drug in to bottle containing dextrose
   Dopamine infusion on cardiogenic shock

Advantages

- Bioavailability is 100%
- Quick onset of action, route of choice in emergency (eg; Diazepam)
- Large volume of fluids can be administrated (eg; I.V fluids)
- Highly irritant drugs can be given (Anticancer drugs)
- Hypertonic saline can be infused (20% mannitol in cerebral oedema)
- By i.v infusion, a constant plasma level of the drug can be maintained (Dopamine infusion in cardiogenic shock)

Disadvantages

- Once drug is injected, its action cannot be halted
- Local irritation may cause phlebitis
- Self medication I not possible
- Strict aseptic conditions are needed
- Extravasation of some drugs can cause injury, necrosis and sloughing of tissues.
- Depot preparations cannot be given by i.v route.

Precaution :

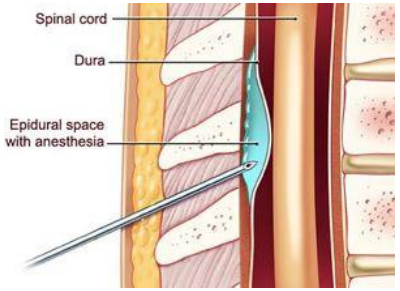
- Inject slowly
- Mack sure that tip of the needle is

Intra arterial route

- This route is rarely employed. It is mainly used during diagnostic studies such as coronary angiography and for the administration of anticancer drugs.

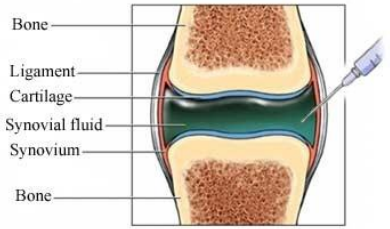
Intrathecal route

- Drugs injected into the subarachnoid space: spinal anaesthetics (eg; lignocaine), antibiotics (Amphotericin B), etc.



intra-articular route

- Drugs injected into the directly joint space.
- Eg; hydrocortisone
- Strict aseptic precautions should be taken. Repeated administration may cause damage to the articular cartilage



Cut-away view of joint

INTRAPERITONEAL ROUTE

INTO THE PERITONEAL SPACE

Advantages : Rapid absorption due to large surface area

Disadvantages :

- Painful, risky due to chances of adhesions and infections in peritoneal cavity.
- Aseptic conditions are needed
- Eg; Antirabies injection, peritoneal dialysis in case of poisoning & Renal failure

INTRAMEDULLARY ROUTE

INJECTION INTO THE TIBIAL OR STERNAL BONE MARROW

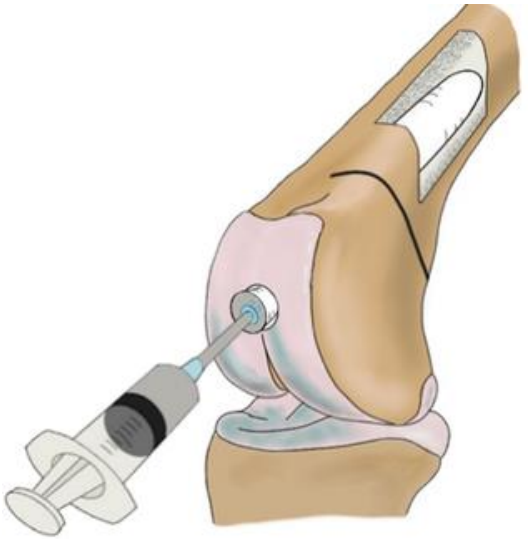
Advantages :

- Onset of action very fast as the vascular spaces or bone marrow communicate directly with the large veins.

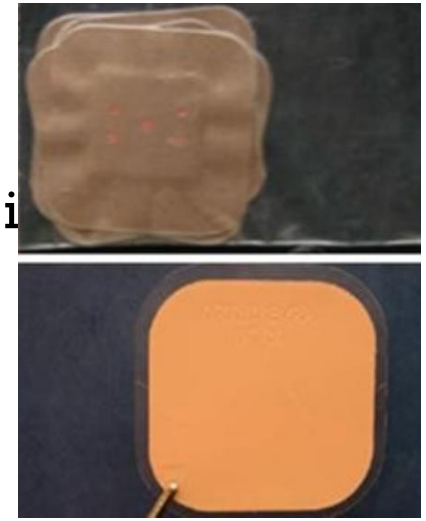
Dias advantages :

- Risky, painful, strict aseptic conditions are needed.

Eg; Bone marrow transplantation, Blood transfusion in children.



TRANSDERMAL ROUTE



- The drug is administrated in the form of patches that deliver the drug i circulation or systemic effect

Eg:

- Scopolamine for sialorrhoea and motion sickness
- Nitroglycerine for angina
- Oestrogen for hormone replacement therapy (HRT)
- Fentanyl for analgesia

Advantages

- Self administration is possible
- Patient compliance is better
- Duration of action is prolonged
- Systemic side effects are reduced
- Provide constant plasma concentration of the drug

Disadvantages

- Expensive
- Local irritation nay cause dermatitis and itching
- Patch may fall off unnoticed

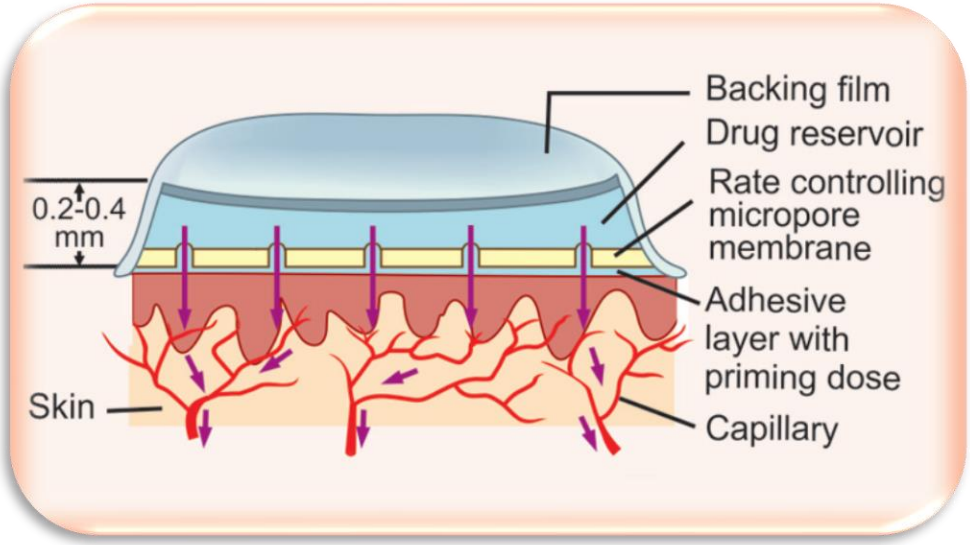
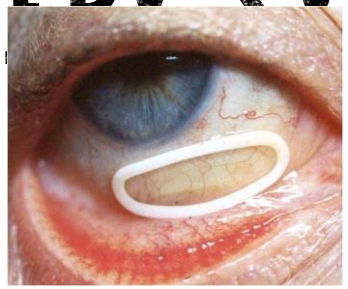


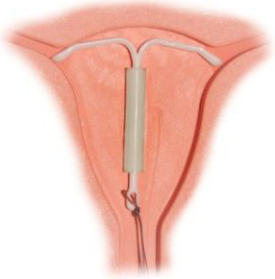
Illustration of a transdermal drug delivery system

SPECIAL DRUG DELIVERY SYSTEMS

1. Ocusert : eg; pilocarpine Ocusert



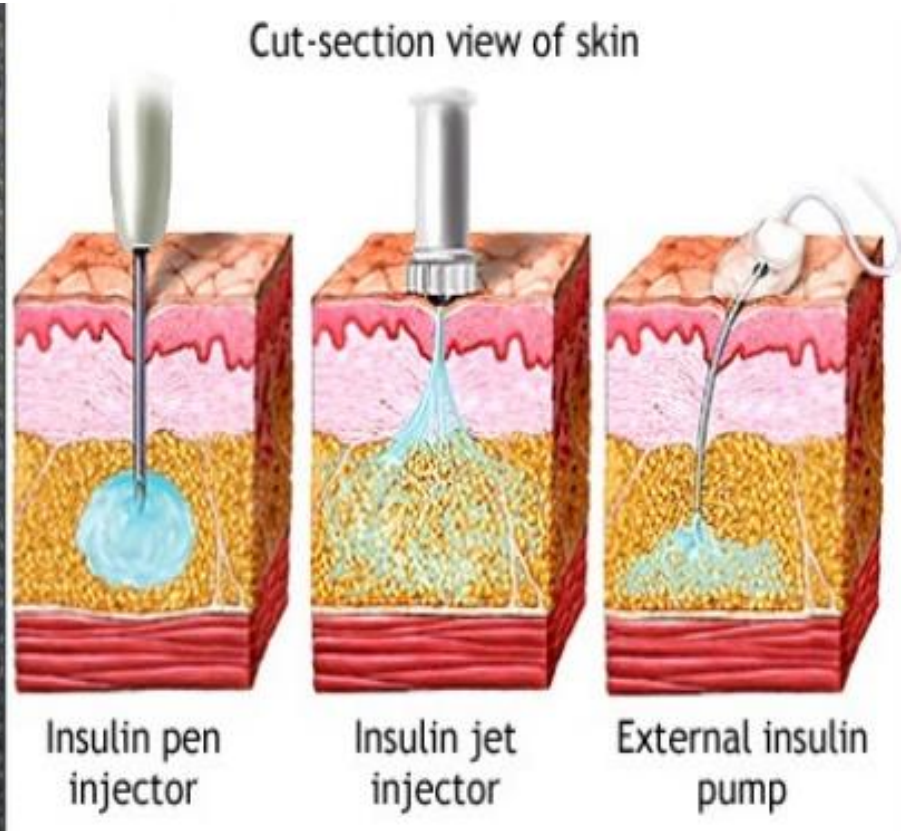
2. Progestasert



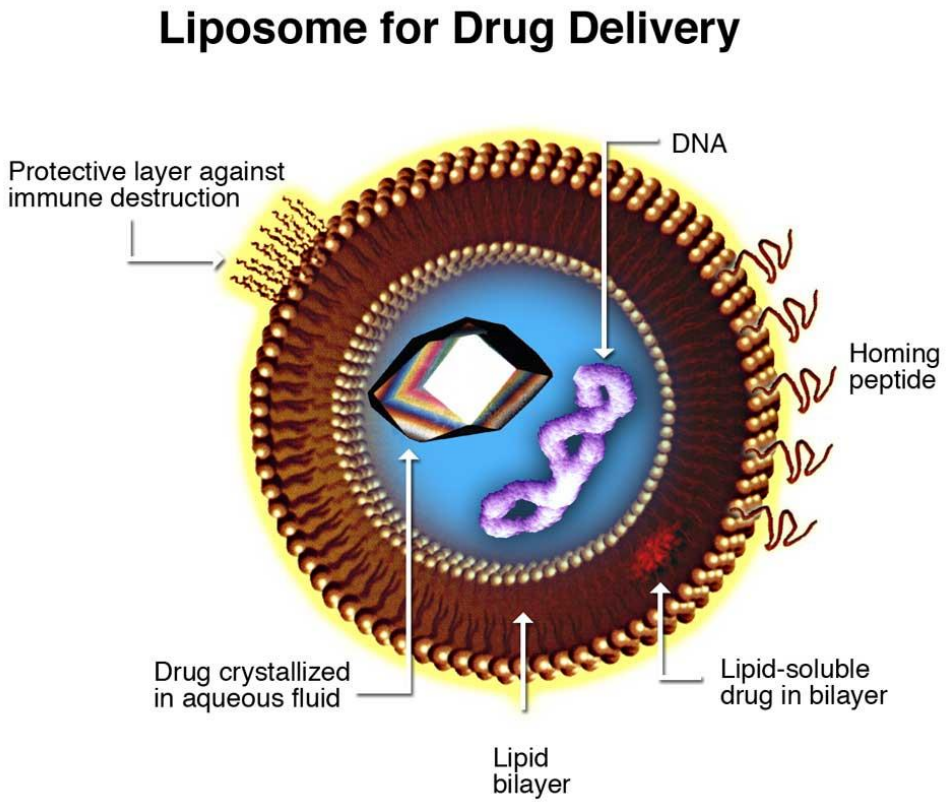
3. Intraoral lignocaine patch

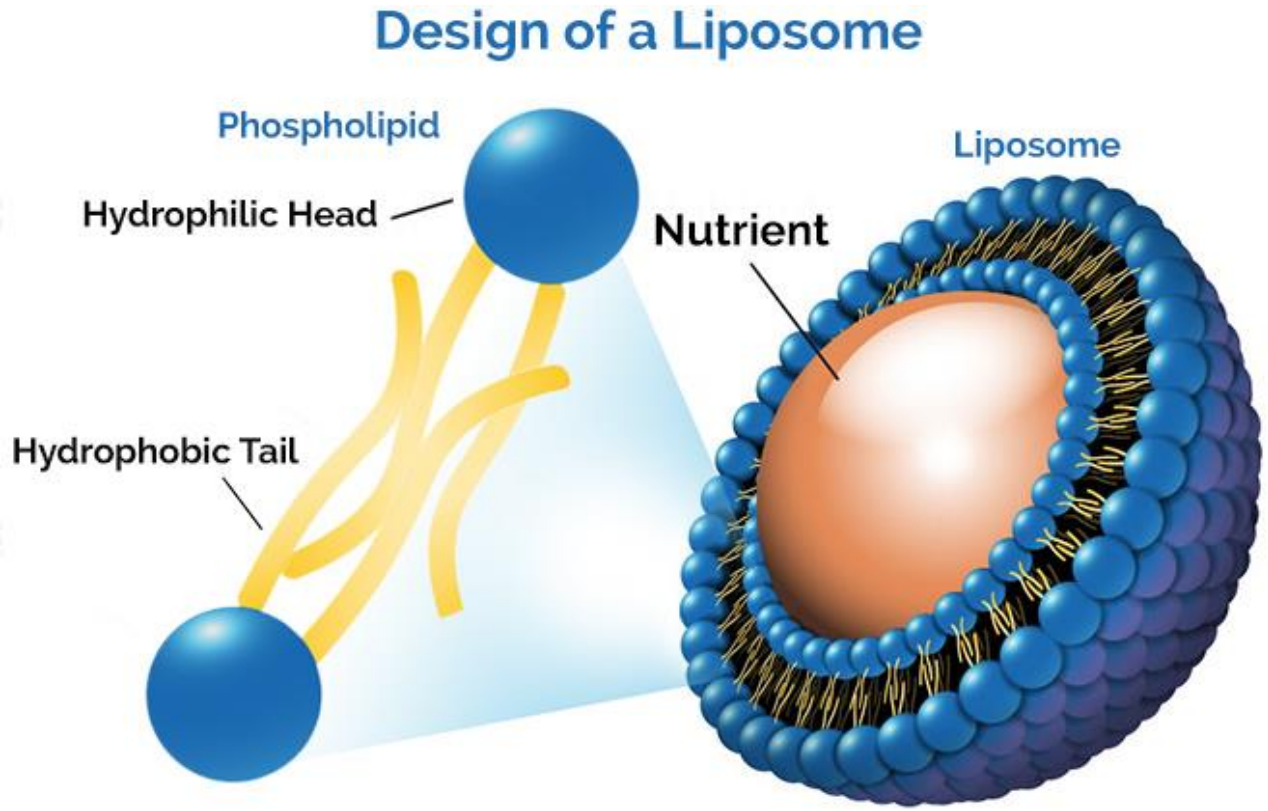
4. Jet injections : with out use of needle eg; local anaesthesia

6. Pens (eg; insulin)



7. Liposomes : they are minute vesicles made of phospholipids into which the drug is incorporated. It helps to targeted delivery of drugs, eg; liposomal formulations of amphotericin B fungal infections





8. Monoclonal antibodies : they are immunoglobulins produced by cell culture, selected to react with a specific antigen. They are useful for targeted delivery of drugs, eg; anticancer drugs

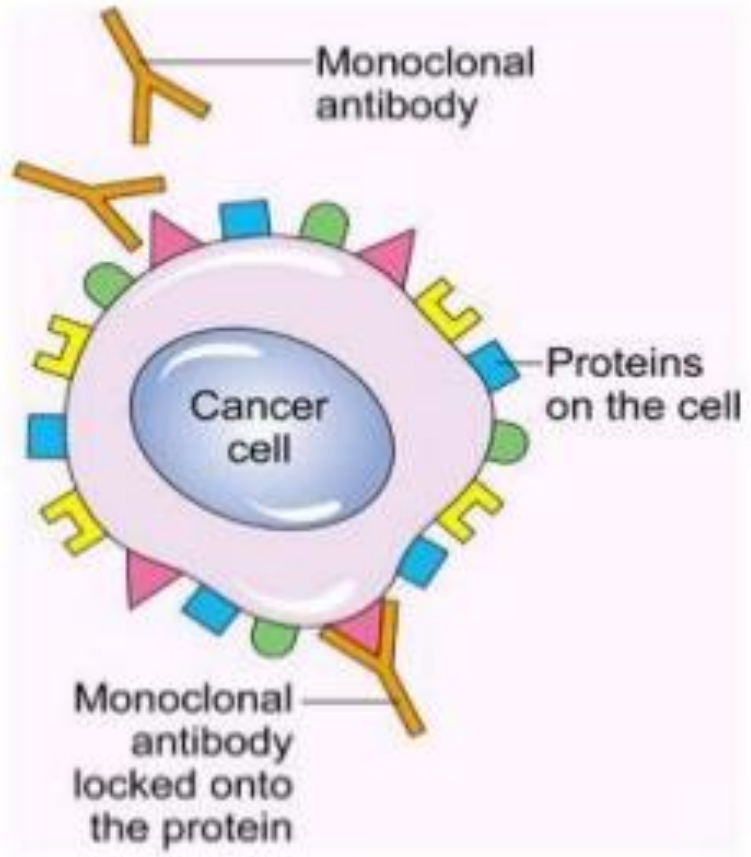
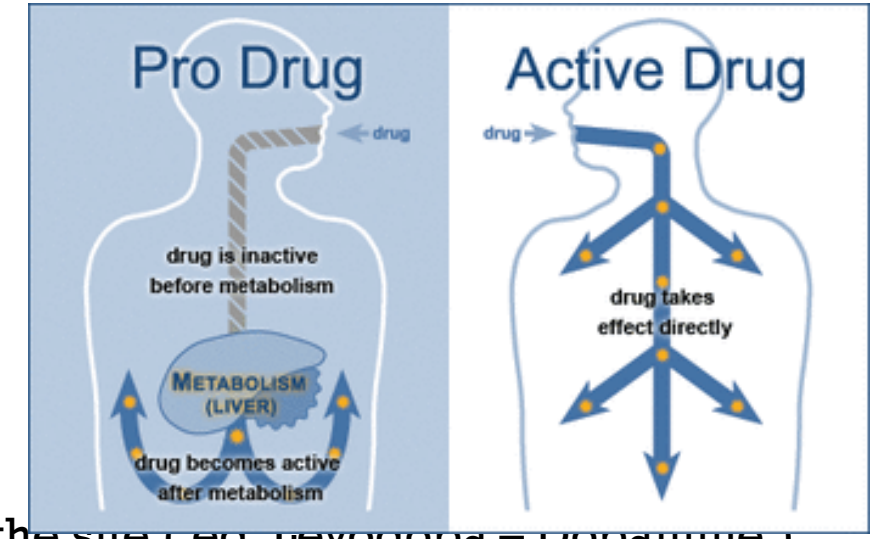


Diagram showing a monoclonal antibody attached to a cancer cel
© CancerHelp Uk

9. Prodrug

Pro drug is an inactive form of a drug which gets metabolites to the active derivative in the boy

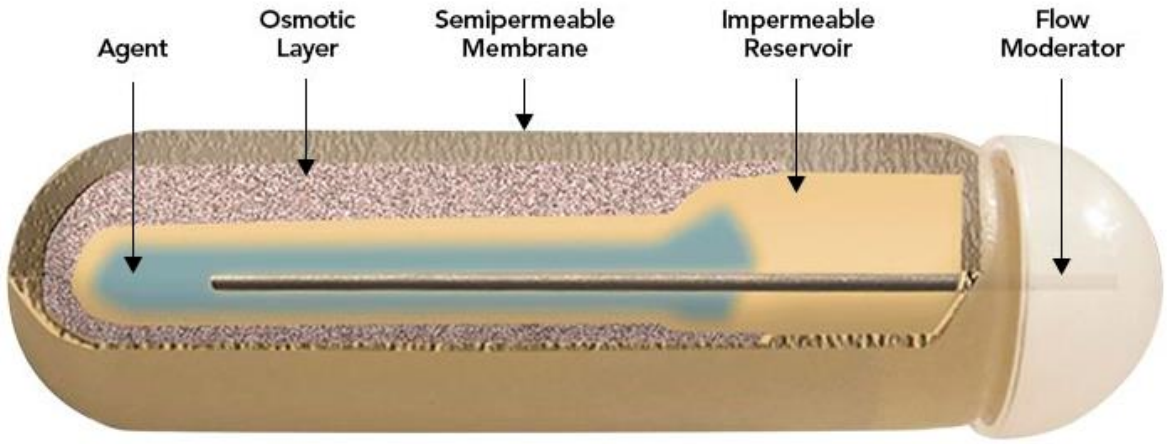


1. Enhance availability at the site (eg; Levodopa – Dopamine)
2. Prolong duration of action (eg; Becampicillin [a prodrug of ampicillin)
3. Improve tolerability (eg; cyclophosphamide – Aldophosphamide [decrease GI toxicity)
4. Drug targeting (eg; Zidovudine , activated in the virus cell)
5. Improve stability (eg; Aspirin – Salicylic acid)

10. Osmotic pumps

3 concentric layers:

1. Rate-controlling, semi-permeable membrane
2. Osmotic layer
3. Impermeable drug reservoir



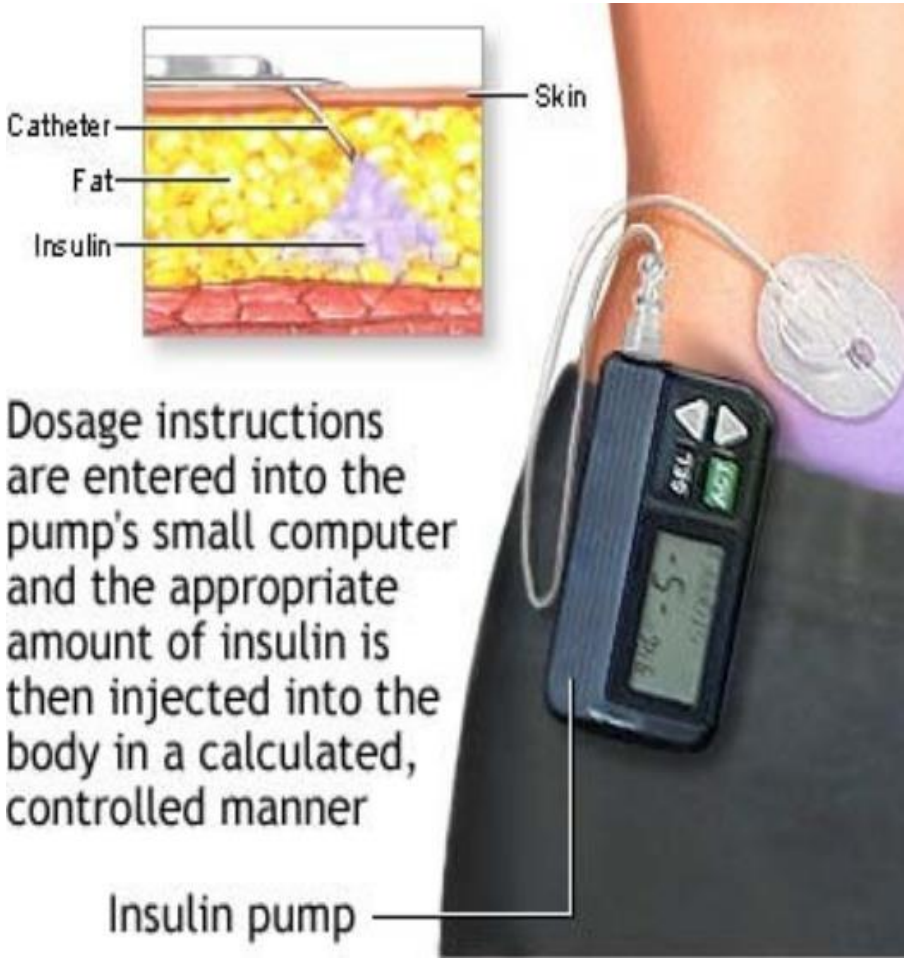
Pumps work by osmotic displacer semi-permeable membrane due to the presence of a high concentration of sodium chloride in the osmotic chamber. The entry of water causes the osmotic chamber to expand, thereby compressing the flexible reservoir and delivering the drug solution through the delivery portal.

This allows slow and constant delivery of the drug over a longer period of time . It also called gastro intestinal therapeutic system (GITS) Eg; iron, Prazosin

11. Computerized miniature pumps

    Eg; CSII - continuous subcutaneous insulin infusion devise

    insulin reservoir program chip keypad display screen



Eg; Patient control anaesthesia (PCA)

Infusion pump

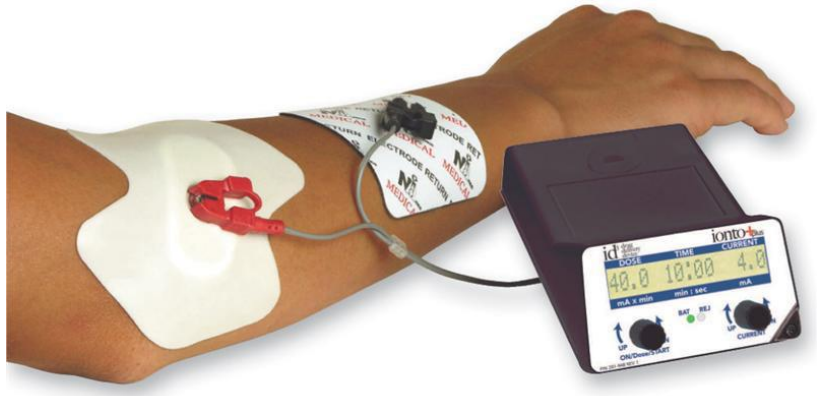
- I/V
- Epidural

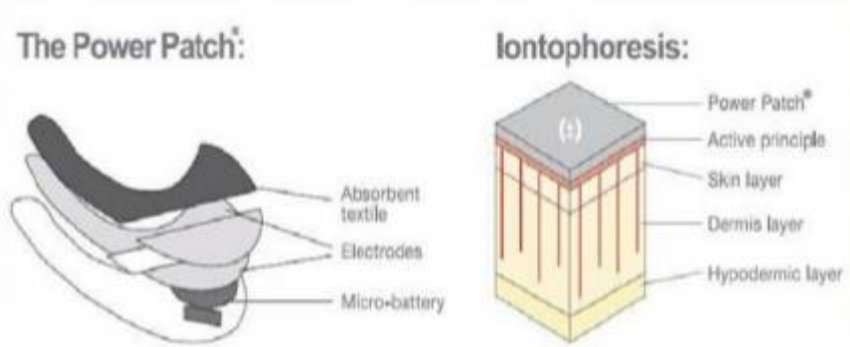
Patient can control the infusion rate and provide the degree of pain control

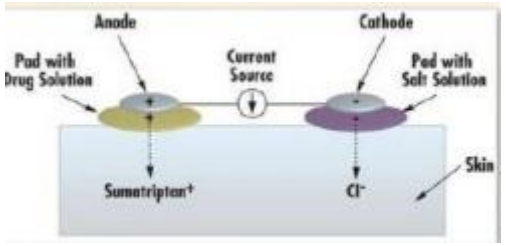
12. Iontophoresis

Mild electric current applied for the transport of drug across the skin

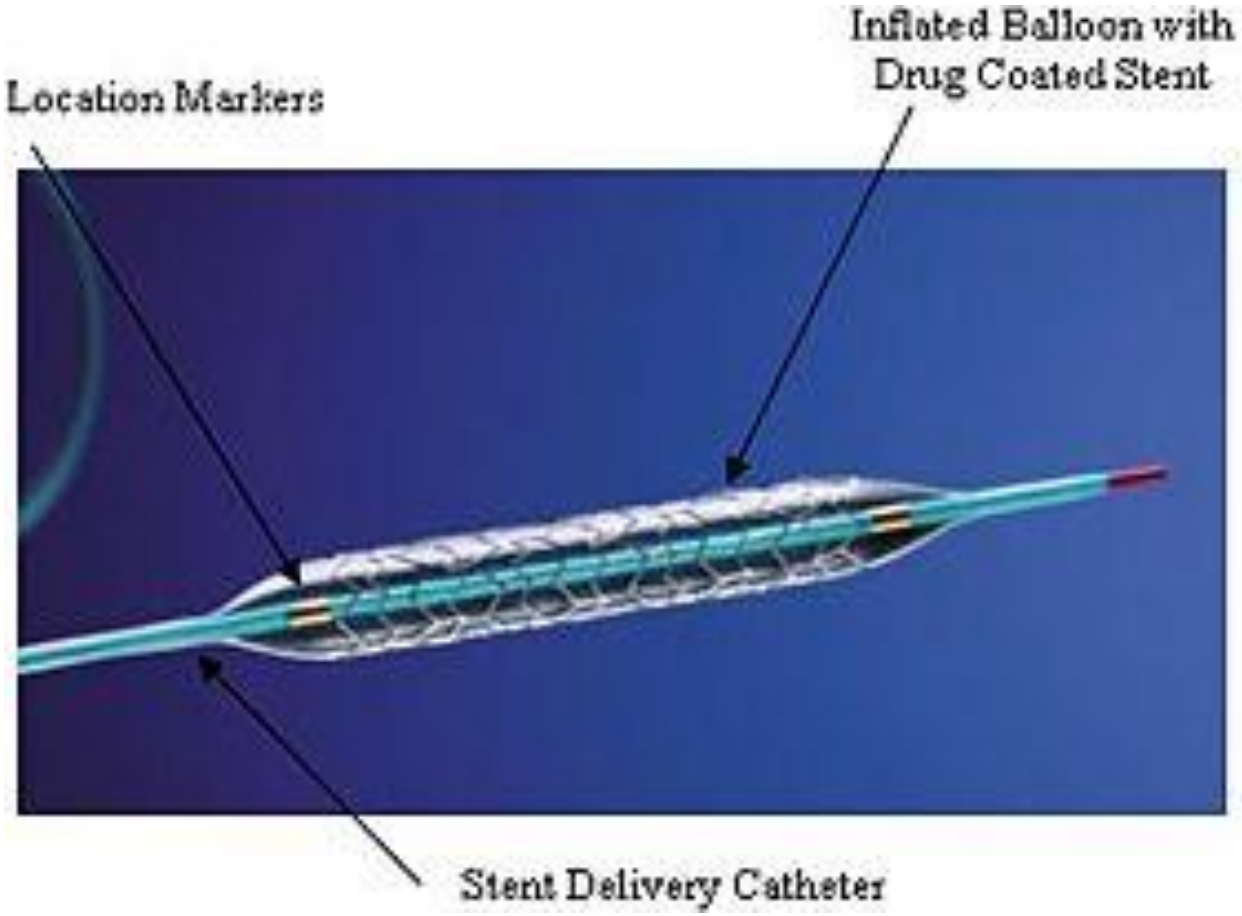
Eg; Vasopressin, Dexamethasone







13. Drug eluting stents
    - Stents can be coted with the drugs embedded in a surface polymer



FUTURE OPPORTUNITIES

1. Gene therapy

   In future drugs my be designed according to individual genotypes, there by enhancing safety and efficacy

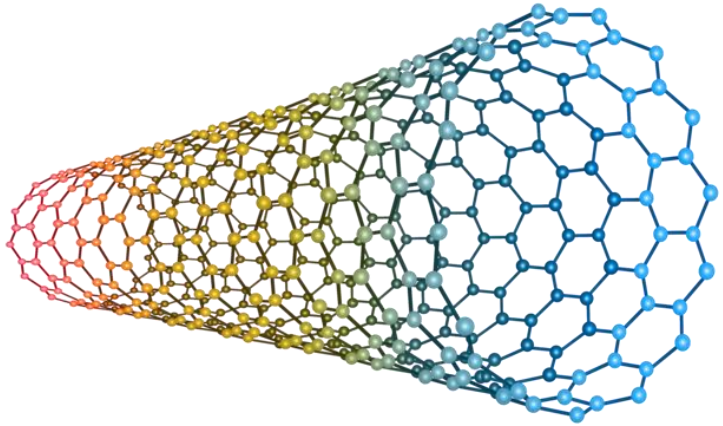
2. Nanoparticles

The drug is encapsulated or dissolved in nanoparticle (NP) matrix to obtained nanocapsules or nanoparticls.

The size 10 to 1000 nm, bio degradable

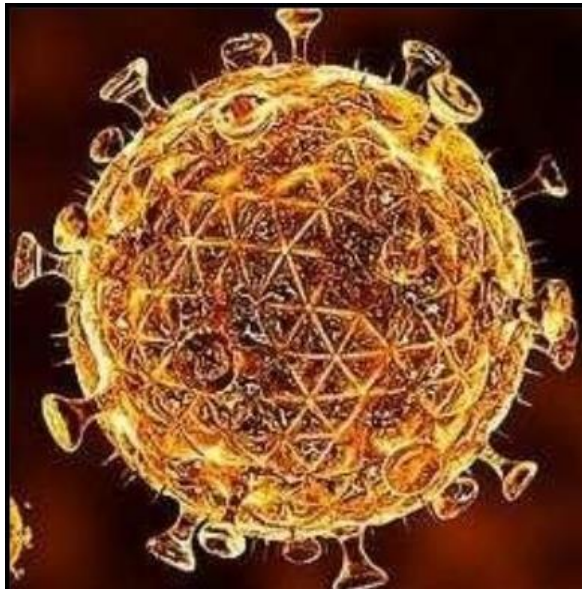
Eg; anti cancer drugs (to improve efficacy and reduce toxicity)

Carbon Nanotubules



Used in treatment of bronchial asthma

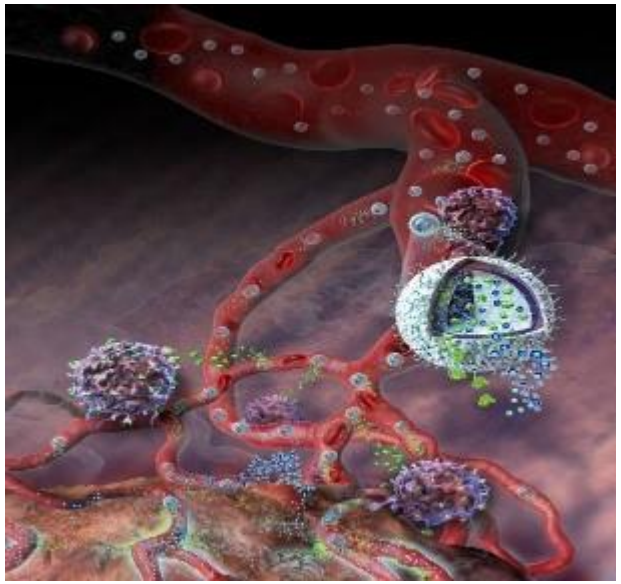
Gold Nanoparticles

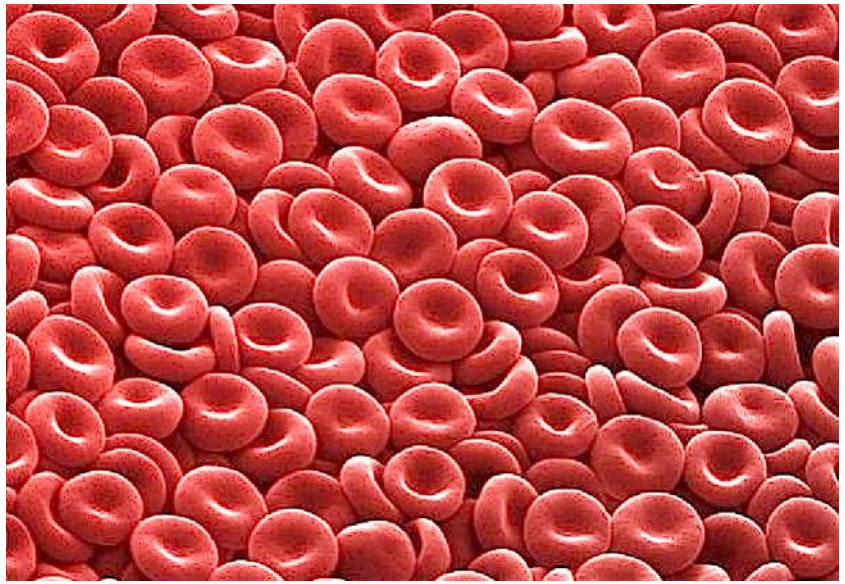


Cancer chemotherapy
- free radical generation

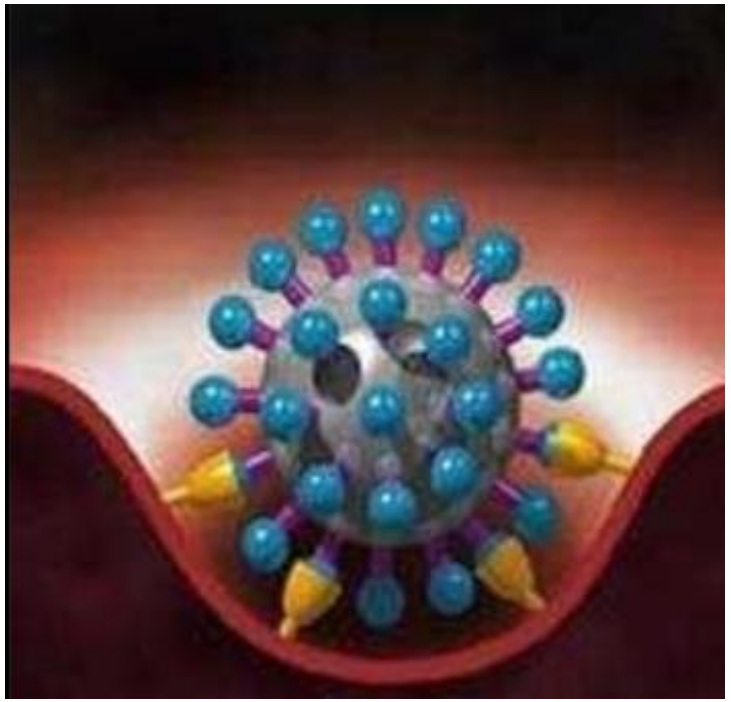
Nanoerythrosomes

- Nanoerythrosomes released erythrocytes hat can carry proteins, enzymes & macromolecules, hey are used in the treatment of liver tumor parasitic diseases & enzyme diseases.



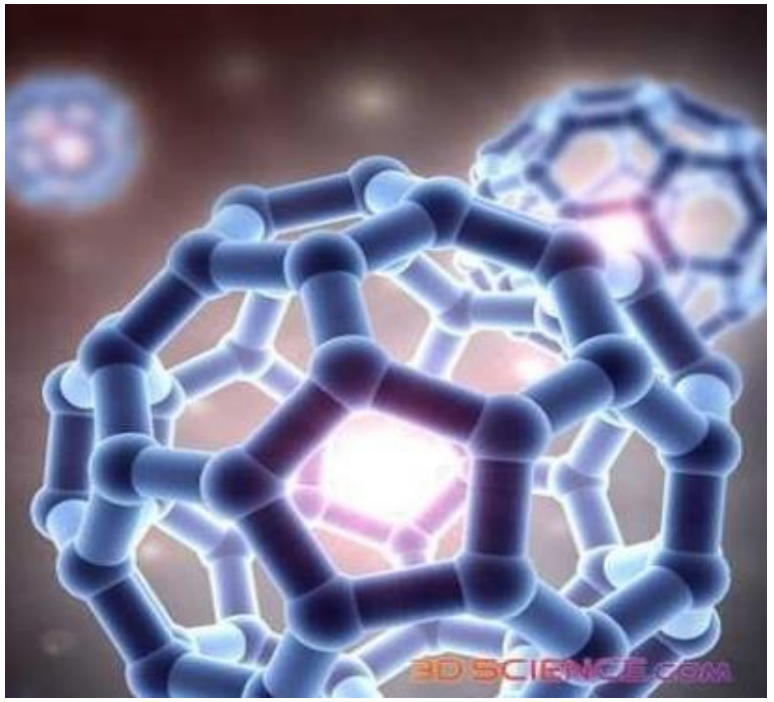


Dendrimer



Dendrimer highly branched globular
Bio degradable synthetic molecule

Modified buckyball



They deliver radio active atoms to cancerous material eg; C-60, against CA colon transfer of radiation is within the ball hence minimize strong radiation to healthy tissue.