

# NASOPULMONARY DRUG DELIVERY SYSTEM

## ❖ Content :-

- Introduction to Nasal and Pulmonary route of drug delivery .
- Formulation of Inhalers.
- Dry Powder
- Meter Dose
- Nasal Spray
- Nebulizer
- Reference.

## ❖ INTRODUCTION:-

- Intranasal drug is now recognized to be useful and reliable alternative to oral and parenteral route.

- Undoubetly , the internasal administration of medicines for the symptomatic relief and prevention or treatment of topical nasal conditions has been widely used for long period of time.

- However , recently the nasal mucosa has seriously emerged as a therapeutically viable route for the systemic drug delivery.

## ❖ Anatomy and physiology of Nasal route :

The nasal cavity of three main region :-

A] Nasal Vestibule :- The nasal vestibule is supported by **the** cartilage of the nose and lined with tissue that contains small, course hairs. The nasal vestibule is completely lined by squamous epithelium

B] Respiratory region :- The Respiratory region is a portion of the mucosa with a cilated epithelium. Major drug absorption 15-20 % of respiratory cells covered by layer of long cilia size 2-4  $\mu\text{m}$ .

C] Olfactory region :- Small area in the roof of the nasal cavity of about 10 cm<sup>2</sup> drug is exposed to neurons thus facilitate it across the cerebrospinal fluid.

Normal pH of the nasal secretions in

adult  $\Rightarrow$  5.5-6.5.

Infants and young children  $\Rightarrow$  5.0-6.7

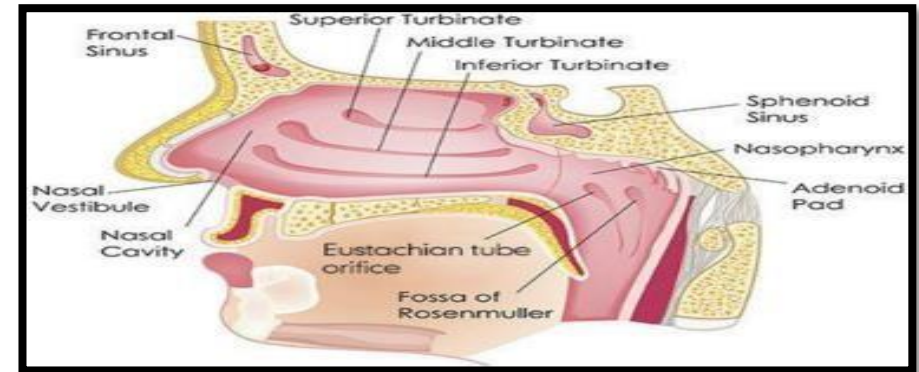


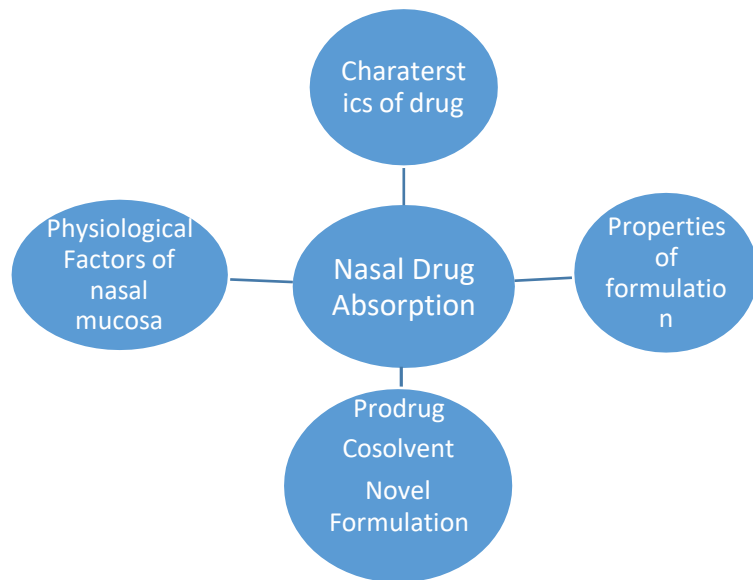
Fig.no. 1:- Anatomy of Nasal route.

## ❖ Mechanism of drug absorbtion :-

Paracellular (intercellular) Slow and passive absorption of peptides and proteins associated with intercellular spaces and tight junctions.

Transcellular: Transport of lipophilic drugs passive diffusion/active transport. Transcytosis Particle is taken into a vesicle and transferred to the cell. Transcellular transport often involves energy expenditure whereas paracellular transport is unmediated and passive down a concentration gradient.

## ❖ Factors Affecting Nasal drug absorption



### Advantages

Qicker onset of action

.Hepatic first pass metabolism avoided.

### Disadvantages

Pathologic conditions such as cold or allergies may alter significantly the nasal bioavailability

Nasal cavity provides smaller absorption surface area when compared to GIT.

## ❖ INTRODUCTION TO PULMONARY DRUG DELIVERY SYSTEM :-

-Pulmonary drug delivery is the inhalation of drug formulation through mouth.

-Delivery of drug directly to their site of action reduces the dose needed to produce pharmacological affect.

-Currently, over 25 drug substances are marketed as inhalation aerosol products for local pulmonary effects and about the same number of drugs are in different stages of clinical development.

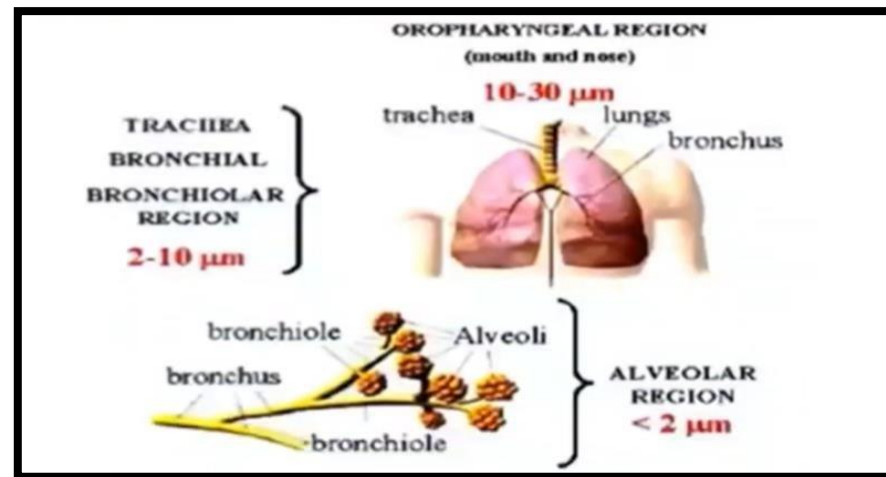


Fig. no. 2 :- Pulmonary Drug Delivery

## ❖ Anatomy of pulmonary route :-

**1 The Conducting Airway :-** The airway is further divided in many folds: Nasal cavity and associated sinuses, and the Nasopharynx, Oropharynx, larynx, trachea, bronchi and bronchioles.

## **2 The respiratory region :-**

a) The respiratory region consist of respiratory bronchioles, alveolar ducts and alveolar sacs.

b) The human respiratory track is a branching system of air channels with approx. 23 bifurcations from the mouth of the alveoli.

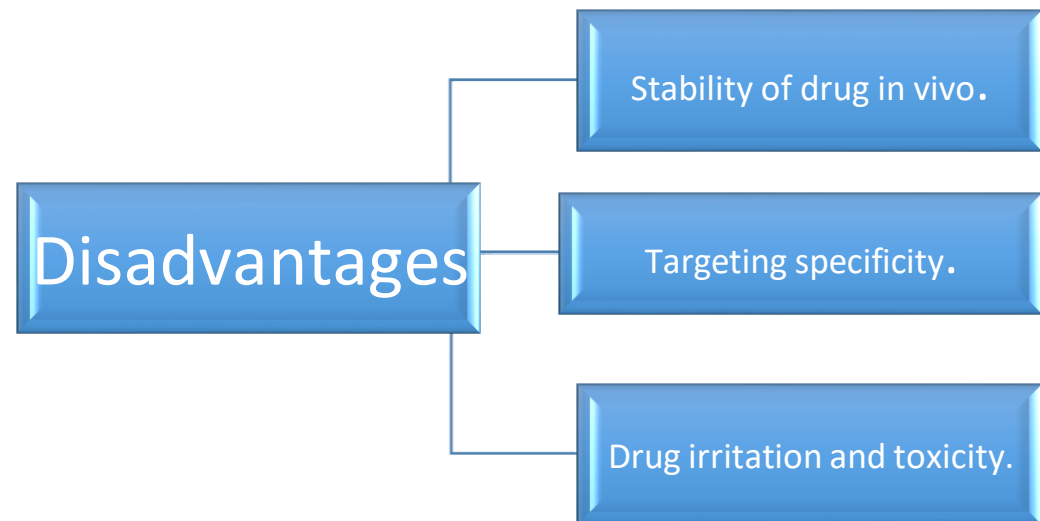
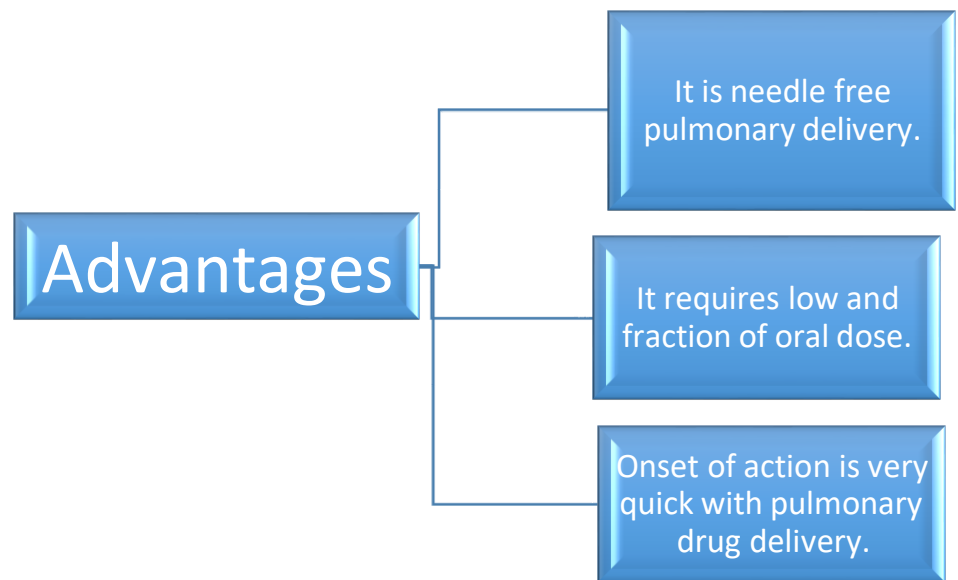
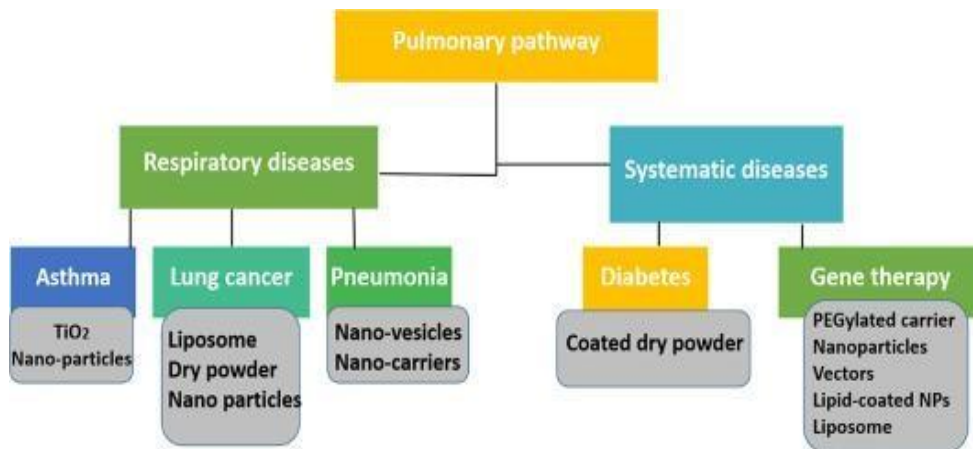
c) The major task of the lungs is gas exchange, by adding oxygen to, and removing carbon dioxide from blood passing the pulmonary capillary bed.

#### ❖ FORMULATION APPROACHES :-

1. Pulmonary delivered drugs are rapidly absorbed except large Macromolecules drugs, which may yield low bioavailability due to enzymatic degradation and/ or low mucosal permeability.

2. Pulmonary bioavailability of drugs could be improved by including various permeation enhancers such as surfactants, fatty acids and saccharides , chelating agents and enzyme inhibitors such as protease inhibitors.

3. The most important issue is the protein stability in the formulation the dry powder formulate on may need buffers to maintain the pH, and surfactants to reduce any chance of protein aggregation.



## ❖ DRY POWDER INHALERS (DPI):-

Dry Powder Inhalers (DPI) is a device that delivers the drug to the lungs in the form of dry powder. DPIs are commonly used to treat respiratory disease such as asthma, bronchitis, emphysema and COPD although DPIs have also been used in the treatment of diabetes mellitus.

1 The patient generates drug aerosol by drawing his breath through loose powder in a DPI.

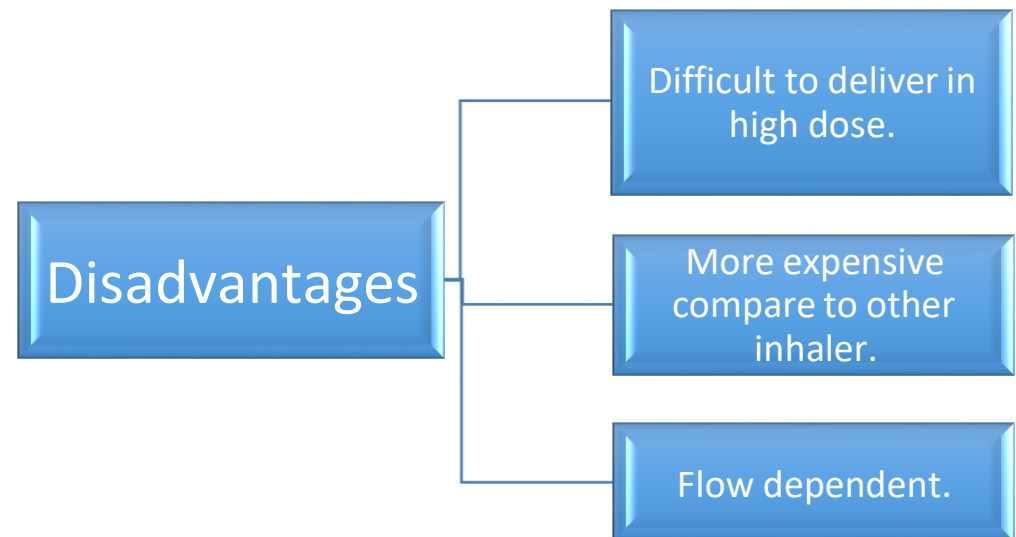
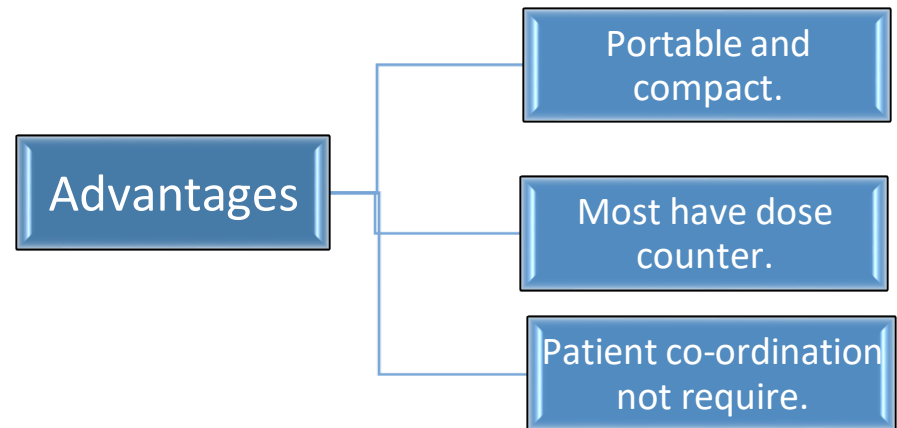
2 Formulation of DPI can be classified into three categories :-

- a) AI Production .
- b) Formulation of API with or without carrier.
- c) Integration of formulation into devices



Fig.no. 3 :- Dry Powder inhalers.

DPIs contain a powder formulation, which most frequently consist of an ordered mixture of micronized drug and larger carrier lactose particles that are require to improve powder flow properties. The patients inhalation through the device is used to disperse the powder and to ensure that some of the dose is carried into the lungs.



### ❖ **METERED DOSE INHALERS (MDI) :-**

A metered-dose inhaler (MDI) is a device that delivers a specific amount of medication to the lungs in the form of a short burst of aerosolized medicine that is usually self-administered by the patient via inhalation.

Meter Dose Inhaler (MDI) has a pressurized container of medication that fits into a mouthpiece.

A dose of medication is released into lungs by pushing the container into the mouthpiece.



Fig. no. 4 :- Metered Dose Inhaler.

1 It is mainly used for treatment of respiratory diseases such as asthma and Chronic obstructive pulmonary disease (COPD).

2 They can be given in the form of suspension or solution.

3 The Particle size of less than 5 microns.

4 It is also used to minimize the number of administrations errors.

5 It can be deliver measure amount of medicament accurately.

### Advantages

Quick to use than other devices.

It reduces dose lose.

No drug prepration is needed

### Disadvantages

Possible dosing error.

Difficult to deliver high dose.

Additional cost.



## ❖ NASAL SPRAY :-

Many medications can be given into the nose with nasal spray. Most of these medications treat problems within the nose and sinus area, such as nasal congestion. Nasal spray are available as over-the-counter or prescription drugs. Nasal spray comes in two forms : a regular spray and a pump spray. It's important to use these products correctly .Make sure they deliver the medication properly so your body can absorb it.

1. **Nasal Gels :-** High-viscosity thickened solutions or suspensions. It has been used for local effects extensively in decongestant and local activity. This drug delivery system may overcome the first-pass metabolism and subsequently improve the bioavailability of the drug. These drug delivery systems exist in sol form before their administration; however, once administered, they undergo gelation to form a gel.



Fig. no. 5 :- Nasal Gels

2. **Nasal Drops :-** Temporary relief of congestion in the nose. Most simple and convenient systems developed for nasal delivery. It has been reported that nasal drops deposit human serum albumin in the nostrils more efficiently than nasal sprays.



Fig. no. 6 :- Nasal drops.

3. **Nasal Spray:-** Both the solution and suspension formulations can be formulated into nasal sprays. Shrinking the blood vessels and tissues in the sinus .Due to availability of metered dose pumps and actuators, a nasal can deliver an exact dose from 25 to 200  $\mu\text{m}$  .



Fig. no. 7 :- Nasal spray

## ❖ NEBULIZERS:-

- Nebulizers are widely used as aerosolize drug solutions or suspensions for drug delivery to the respiratory tract and are particularly useful for the treatment of hospitalized patients.
- There are two basic types:
  1. Air jet nebulizer
  2. Ultrasonic nebulizer
  3. Mesh nebulizer

### 1 Air jet Nebulizer :-

A jet nebulizer is a machine that turns certain liquid medicines into a fine mist that your child simply breathes in through a face mask or mouthpiece. And it delivers the medicine straight to your child's lungs, where it is needed.

In these compressed air is forced through on the orifice on area low pressure is formed where the air jet is exists . They are easy to use and inexpensive .



Fig. no. 8 :- Air jet nebulizer.

### 2 Ultrasonic Nebulizer :-

It is based on the vibration of a piezoelectric crystal driven by an alternate electric field. Ultrasonic nebulizer are used fast & directed with reduced noise levels. The only drawback medication restriction.



Fig.no. 9 :- Ultrasonic nebulizer.

**3 Mesh Nebulizer :-**High nebulization capacity  $> 0.25 \text{ m} / \text{min}$  device after short. Inhalation time. Technique vibrating piezoelectric element at bottom of liquid . They use a mesh cap with tiny holes to help dispense medication into consistent particle sizes that can be easily and comfortably inhaled



Fig. no. 10 :- Mesh Nebulizer.

### ❖ Marketed Preparation :-

- |                 |                 |
|-----------------|-----------------|
| 1 Azelastine    | 3 Beclometasome |
| 2 Levocabastine | 4 Mupirocin     |

1 Azelastine :- Azelastine , an antihistamine is used to treat hay fever and allergy symptoms including runny nose, sneezing, and itchy nose.



Fig. no. 11:- Azelastine Liquid

2 Levocabastine :- Is use to relieve allergy symptoms in the nose.



Fig. no. 12 :- Levocabastine Semisolid

3 Beclometasome :- Use to treat cold like symptoms caused by allergic rhinitis.



Fig. no. 13 :- Beclometasome Liquid

4 Mupirocin :- Use to treat infections that are caused by certain bacteria.



Fig. no. 14 :- Mupirocin Liquid

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