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Pulmonary Drug Delivery: Role and Application of Lipid Carriers

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ABSTRACT
The present review describes all the aspect of pulmonary drug delivery system and recent advancement. It deals with the delivery of drugs in important disease conditions like asthma, COPD, lung cancer and cystic fibrosis. These disorders required prolonged delivery of the drug through pulmonary route. Various drug loaded lipid formulation like spherulites, lipid nanoparticles, exosomes, solid lipid nanoparticles, nano structured lipid carriers, Janus particles, liposomes, self-micro-emulsifying drug delivery system, lipospheres and RBS derived nanovesicles are discussed. The pulmonary drug delivery system offers important system to deliver the drug to the targeted site.

Keywords: Pulmonary drug delivery system, Lipid carriers, Polymeric carriers, lipid nanoparticles, liposomes, spherulites, exosomes, solid lipid nanoparticles, nano structured lipid carriers, Janus particles, self-micro-emulsifying drug delivery system, SMEDDS, lipospheres, RBS derived nanovesicles, Dendrimers, nanocapsules, nanospheres

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INTRODUCTION

An effective treatment depends on the techniques on how the drug is delivered and the quantity or the dose of the drug that is given, concentration above or below the prescribed dose can be toxic or of no therapeutic use. The effectiveness of the drug and its treatment can be achieved by controlling pharmacokinetics, pharmacodynamics, immunogenicity, and bio recognition, these along with interdisciplinary approach such as polymer science, pharmaceutical technology, bio-conjugate chemistry, and molecular biology, are often called novel/advanced drug delivery systems. There exist different drug delivery system and drug targeting system that are currently being developed to reduce the drug loss and drug degradation with increased efficacy (1).

Pulmonary drug delivery system has attracted large scientific and biomedical interest as the pulmonary route has several advantages over the systemic delivery of the same drug in treating respiratory diseases like asthma, chronic obstructive broncho-pneumopathy due to the capability of the lungs in absorbing pharmaceuticals either for the local or systemic delivery. Systemic absorption can also be achieved through alveolar administration of therapeutic agents and is proved to be more beneficial. Through inhalation the deposition of the drug in lungs is rapid with little side effects when compared through other route of administration, because of high permeability, large absorptive surface area of lungs and is with good supply of blood. Pulmonary route is gaining more attention as non-invasive administration of the therapeutic agents to both the local and systemic delivery (2-4).Though pulmonary route it is likely to target drugs to specific cell like macrophages, lymphocytes, neutrophils, endothelial cells or epithelial cell or the cell organelles, here the nature of the material used in the drugs affect the rate of uptake. It has been observed that the alveolar epithelium of the distal lungs is the absorption site for most of the therapeutic agents and other molecules (5-8). Up to now, the delivery of drug through pulmonary means was to treat asthma and Chronic obstructive pulmonary disease (COPD), but recent advancements and research development in the technologies this route is not confined in treating respiratory related disease only, several literature have reported the therapeutic use of pulmonary route in other areas such as diabetes, virus infection and cancer (9) pulmonary hypertension, systemic use of insulin, human growth hormone and oxytocin (10-16).

Benefits of the pulmonary drug delivery:

- As mentioned earlier, Lungs has a large surface area (approximately 100 m^2) for the absorption or deposition of the therapeutic agents, and it is supplied with blood that paves the way for systemic delivery of the agents.
- Prevents the degradation of the drug in the GI tract and bypass the first pass metabolism in liver due to decrease in the activity of enzymes involved in drug metabolism (6)
- Limits the penetration of the drugs into the blood and thereby limits the accumulation into the healthy organs
- In majority of the cases the use of systemic delivery of drugs to treat lung diseases proved to be of low efficacy rate and with severe side effects on the healthy organs
- The action of the drug is rapid through inhalation (in min.) as compared to the oral dose (which may take hours)

Challenges faced by pulmonary route.

- Low efficiency of inhalation system
- Less drug mass per puff
- Poor formulation stability for drug
- Improper dosing reproducibility

To ensure increase in the efficiency of the treatment, the pharmaceutical agents must target the disease cell and decrease the exposure of the toxic drug to the healthy organs, its ideal to give the therapeutically active agent directly through inhalation. An ideal pulmonary formulation must ensure that the drug is targeting specifically to the disease and limiting the exposure to the surrounding healthy cells and with decrease saturation in the circulatory fluid (circulation).