Research & Reviews: Drug Delivery

Various Approaches of the Pulmonary Drug Delivery in Respiratory Issues

Awayne Scultz*

Department of Pharmacy and Pharmaceutical Sciences, University of Alberta, Alberta, Canada

Commentary

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***For Correspondence:**
Awayne Scultz, Department of Pharmacy and Pharmaceutical Sciences, University of Alberta, Alberta, Canada

E-mail: awaynchultz@mail.ubc.ca

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DESCRIPTION

Pulmonary drug delivery is a method of administration whereby patients inhale their prescribed drugs in the form of an inhaler and the medications are absorbed into the circulation across the lung mucous membrane. This method is most often used to treat lung disorders such as asthma and chronic obstructive pulmonary disease (COPD). Metered-dose inhalers (MDI), dry powder inhalers (DPI), soft mist inhalers (SMI), and nebulizers are examples of inhalers. Owing the drug has targeted absorption through the lung, pulmonary medication administration reduces systemic side effects and boosts bioavailability. The drawbacks include potential lung irritation, limited drug solubility, relatively high drug clearance, and drug effectiveness is dependent on inhaler tactics and patient compliance.

Substance particle characteristics, breathing patterns, and respiratory tract geometry have an impact on the rate and efficacy of pulmonary medication delivery. Because the medication being used must penetrate the respiratory tract's defensive mechanisms, drug formulation might be difficult. The drug's pharmacokinetics and pharmacodynamics in older patients can also be difficult to anticipate due to age-related changes in body composition.

Ongoing advancements in inhaler device engineering, technology, and drug formulations may improve efficacy and overcome pulmonary drug delivery problems. Innovative developments include the use of the pulmonary route as an entry point into systemic circulation for the treatment of many diseases, as well as the development of pulmonary drugs formulation and particle engineering technology with the goal of enhancing pulmonary delivery efficacy.

Types of inhalers used in pulmonary drug delivery

Metered-Dose Inhalers (MDIs): Pressurized metered-dose inhalers (pMDIs) and breath-actuated metered-dose inhalers (BAMDIs) are two types of metered-dose inhalers. The most often used inhalers for treating lung illnesses are pMDIs. It is necessary to coordinate patients' inhalation and inhaler actuation. MDIs with spacers provide comparable medication delivery performance to nebulizers, with added benefits in convenience and cost-efficiency. Some of the benefits include excellent portability, a fixed dosage is administered, aerosolized medication particle delivery that is effective, Inexpensive, Convenient application and quiet administration. Drawbacks include inhalation and inhaler actuation must be coordinated.

Dry Powder Inhalers (DPIs): The exertion of the patient's inspiratory flow causes the solid medication granules in DPIs to be discharged. The movement of airflow and resistance inside the inhaler are related to the turbulent airflow generated by the inhaling force. With the goal to overcome DPI resistance and achieve successful pulmonary delivery, patients should inhale with adequate inspiratory flow. Advantages include excellent portability, a fixed dose is administered, and Inhalation and inhaler actuation must be coordinated as little as possible. Disadvantages include patients must provide appropriate inspiratory flow and sensitive to moisture.

Soft Mist Inhalers (SMIs): The soft-mist inhaler used the energy provided by the lever-compressed spring to aerosolize a fixed dose of liquid medication formulation into inhalable microscopic particles via an unusually fine nozzle system. The patient's coordination between inhaler actuation and inhalation is aided by the slow and prolonged rate of aerosolization. High portability is one of the benefits. Minimal patient coordination is required between inhalation and inhaler actuation; high medication accumulation in lungs.

Some disadvantages are as follows; Market availability is limited, and it is relatively pricey. Some irritating medication particles may also produce local side effects in the respiratory tract, such as dysphonia and oral thrush from inhaled corticosteroids collecting in the oropharynx. Furthermore, drug dosing may be imprecise due to individual differences in breathing patterns and the existence of several factors influencing the deposition and absorption of drug particles in the lungs. Elder patients, in particular, may lack the strength to generate sufficient inspiratory flow, resulting in reduced drug inhalation and, as a result, low drug bioavailability. Finally, inhalers, particularly nebulizers necessitate frequent maintenance and cleaning. Inhaler devices are more expensive than oral tablets, which may be out of reach for low-income people.

Ongoing developments

Because of the added benefits of bypassing hepatic first pass metabolism, quicker systemic absorption, improved patient compliance, and its non-invasive character, the use of the pulmonary route as an entry into the systemic circulation is constantly expanding. For disorders requiring systemic drug delivery, potent medicines having the ability to penetrate the lung mucosa and enter the bloodstream may be available. The use of inhaled nicotine for smoking cessation, the use of inhaled levodopa for Parkinson's disease treatment, and the pulmonary administration of various biologics are all current studies.

In addition to the development of new pulmonary medications, drug formulation and particle engineering technology is progressing, such as the utilization of the Ultrasound Mediated Amorphous to Crystalline Transition (UMAX) technique to micronize amorphous to crystalline transition.