Treating chronic obstructive pulmonary disease (COPD) in elderly patients: Present approaches and prospective paths


Binu Raina*, Abhimanyu
Chaudhary Devi Lal College of Pharmacy, Jagadhri, Haryana
Email: binuraina407@gmail.com

Abstract
Chronic obstructive pulmonary disease (COPD) is a common, curable, and preventable illness marked by ongoing breathing problems that get worse over time as a result of increased lung inflammation brought on by dangerous gases or particles. COPD is more common in older persons. This review summarizes the management of COPD in older patients along with the basic medication, the delivery system available for the treatment, and the challenges encountered while delivering the medication. Furthermore, we will also discuss the novel approaches that could be found suitable to accelerate the efficacy of the treatment.

Keywords: Chronic obstructive pulmonary disease, Management of COPD, Inhaled delivery system, Innovative approaches

1. Introduction

The widespread condition is known as chronic obstructive COPD is treatable and preventable. It is characterized by persistent respiratory difficulties that often worsen with time. This results from heightened lung and air inflammation from harmful gasses or particles. Flare-ups and other linked health problems might exacerbate the illness (1). Emphysema, which causes parenchymal damage and the loss of alveolar septa, and chronic bronchitis, characterized by persistent airway inflammation, are the two primary diseases historically used to characterize COPD (2). In elderly persons, COPD is particularly problematic. Older people naturally have less flexible and effective lungs, which increases their susceptibility to respiratory conditions like COPD. The health of tissues gradually deteriorates with age, which hurts the structure and operation of vital organs. Age-related illnesses result when the body's built-in antioxidant and anti-inflammatory defences are weakened by prolonged low-level inflammation and elevated reactive oxygen species (ROS). This imbalance causes harm to cells and tissues, which can accelerate the onset of COPD in older persons, particularly when paired with other well-known risk factors like

smoking cigarettes (3). Even two years after an exacerbation, a patient's condition can continue to deteriorate from its usual day-to-day variance, which has a detrimental effect on their well-being and raises their BODE index (4). Patients with COPD, especially those who are elderly, frequently have coexisting chronic conditions like atrial fibrillation, hypertension, thyroid dysfunction, congestive heart failure, and coronary artery disease (5).

2. Management of COPD in elderly patients

The use of medications to treat COPD in the geriatrics is a current concern. Older people can benefit from the same therapy strategies as are recommended for COPD patients. However, when prescribing for older patients, there are some general factors to take into account about aging like changes in lung mechanics associated with aging, nervous system control, diminished metabolism, renal and hepatic insufficiency, weight loss, increased body fat, decreased body water, comorbidity and the impact of aging on absorption influencing the pharmacokinetic behavior of administered drug therapies and, it is also considered how well conventional COPD drugs work (6). Helping with symptoms and preventing flare-ups is the primary objective of contemporary COPD treatment. The use of medications that assist open up the airways (such as beta2-agonists and antimuscarinic pharmaceuticals) and decreasing inflammation with inhaled corticosteroids (ICS) are crucial components of the treatment strategy for persons with COPD, according to the global recommendations for the disease. It has been reported that Long-acting beta-2 adrenergic receptor agonists have the potential to aggravate irregular heartbeats and raise heart rates, particularly in COPD patients who already have low oxygen levels and cardiac rhythm issues (7). It has been suggested that for individuals with COPD who also have ischemic heart disease, hypertension or specifically heart failure, β-blockers are a useful substitute. Even with the use of long-acting muscarinic antagonists (LAMAs) and long-acting beta-agonists (LABAs), if the patient has shortness of breath, difficulty with exercise, or frequent flare-ups, it is advised to add an inhaled corticosteroid (ICS) to dual bronchodilation for the treatment of COPD. Research has indicated that an individual's reaction to corticosteroids tends to diminish with age. This implies that older people may require greater corticosteroid dosages. Doses that are acceptable for younger individuals, however, can put elderly patients at higher risk of infection (8). Many efforts are being made to create drugs that prevent the recruitment and activation of inflammatory cells in the lungs of COPD patients. New targets have been found for efficient treatment, and new treatments have been created for these targets (9).

2.1. Compliance with treatment

The chronic nature of COPD, the need for several drugs, and the delayed onset of symptoms all contribute to poor adherence to therapy among patients, particularly older persons. Nonadherence is made worse by elements like aging, comorbidities, depression, cognitive decline, cultural obstacles, and anxiety about negative drug effects. Patients frequently forget second doses during the day, struggle with breathing techniques, and miss dosages. Therapy expenses also contribute to suboptimal dosage patterns and primary nonadherence. Developing focused therapies that target the unique obstacles elderly patients face such as cognitive impairments, polypharmacy, and immobility is essential to boosting adherence. Real-time adherence data can be obtained by utilizing technology such as smart inhalers, evaluating the effects of using numerous inhalers, and providing continuous assistance for inhaler technique. Better adherence can also be supported by involving caregivers and utilizing compensatory techniques, such as routines and technology-based reminders. To find the best strategies for enhancing drug adherence in older COPD patients, more study is required (6).

3. Delivery systems for COPD

Elderly people with COPD can be managed using a variety of inhaler devices. Therapeutic chemicals are delivered as aerosols via inhaler devices that are built on one of three platforms:
Pressurized Metered-Dose Inhalers, Nebulizers, and Dry powder inhalers.

3.1. Pressurized metered-dose inhalers

The first portable drug delivery devices were pressurized metered-dose inhalers (pMDIs), the design of which has remained essentially the same for more than 60 years. They are made up of an aluminum canister with a plastic holder that holds a pressurized suspension or solution of propellants and medication particles. A precise dose is released every time the device is utilized thanks to a metering valve. Surfactants are added to inhaler brands to help avoid particle clumping and give them a unique flavor. The original push-and-breath method, which involves pressing the canister to release the medicine as an aerosol, is still used in modern pMDIs. The delivery has been enhanced by switching from hydrofluorocarbon (CFC) to hydrofluoroalkane (HFA) propellants, resulting in a softer spray that is more likely to enter the lungs (10). Aside from the benefits, pressured MDIs have significant drawbacks. For example, many patients may find it challenging to use. According to study issues include weak muscles as a result of diseases like arthritis or stroke, poor hand-breath coordination, and problems with fine motor control (11).

3.2. Dry powder inhalers (DPIs)

DPIs are medical devices that inhale medicine in a dry powder form into the lungs for therapeutic purposes. Propellers are not needed because the powder is drawn from the device and carried into the lungs by the patient's breath. Patients can use them more easily as a result. While some DPIs use prefilled cartridges or reservoirs to hold several doses, others only administer a single dose via a capsule (10). DPIs are small, portable, and deliver quickly, but using them is complicated. Every inhalation necessitates loading the device with a powder capsule; elderly patients may find it especially challenging to open the blister packs containing these capsules. Common mistakes done by patients are as follows: not holding their breath after inhaling, not exhaling deeply and quickly, and blocking the mouthpiece with the tongue. These mistakes are more common in fragile patients, neurologically changed, cognitively incompetent, or incapable of following directions (12).

3.3. Nebulizers

Nebulizers are the delivery systems that offer an effortless delivery of medicament even at higher dosages. There are numerous varieties of nebulizers on the market, and research has shown that nebulizers from the same manufacturer as well as other manufacturers work differently from one another. The three primary nebulizer types operate in distinct ways: an ultrasonic nebulizer, jet nebulizer, or membrane including vibrating crystal, compressed gas, and vibrating mesh, respectively. Newer nebulizers are battery-operated, portable, and smaller than their larger, bulkier predecessors (10). Nebulizer use necessitates routine cleaning, comprehensive usage, and hygienic guidelines, as well as support and maintenance schedules (13).

Thus every elderly patient should receive customized inhaled therapy for COPD. These patients' cognitive, physical, and educational capacities should all be taken into consideration while choosing an inhaler device.

4. Innovative treatments and future outlook for COPD therapy

The ongoing search for effective COPD treatments has yielded promising results with new drugs like ensifentrine/RPL554, AQX-1125, and SRT1720 showing significant potential. The development of RNA therapeutics, including siRNAs and ncRNAs, offers innovative approaches to mitigate COPD symptoms and progression. Natural medicines such as ginseng and Paeonia also demonstrate valuable anti-inflammatory and antioxidant properties, highlighting the potential of complementary and alternative therapies in COPD management. Continued research and clinical trials are essential to validate these findings and translate them into effective treatments for COPD patients (14).

Potential COPD treatments have entered a new and inventive era thanks to nanomedicine. The capacity of nanotechnology to develop cutting-edge drug delivery systems that allow for a higher degree of precision when delivering the medication to the target site has proven to be a highly sought feature. Additionally, nanotechnology allows for a precise and regulated dosage, potentially resulting in a lower frequency of administration. When compared to the medications that are currently on the market, nanoparticle-based drug delivery systems would undoubtedly enhance the quality of life for COPD patients while causing fewer side effects (15).

Nanomedicine, which includes, among other things, polymeric nanoparticles, micelles, nanotubes, silver and gold inorganic nanoparticles, and liposomes, has demonstrated great potential as a viable treatment alternative for treating severe respiratory disorders. Drugs are better protected and stabilized by nanoparticles, which also allow for tailored administration to particular regions. Compared to alternative approaches, this focused strategy improves therapy efficacy while also minimizing adverse effects for patients (16).

Liposomes' capacity to retain size, carry a therapeutic payload, and prevent aggregation following aerosolization makes them ideal for use as dry powder inhalers. They facilitate controlled release of the medication from lung cells, extended retention, and improved drug accumulation in the lungs. Neutral and negatively charged liposomes are more biocompatible than cationic ones, which makes them ideal for medication delivery—particularly when it comes to targeting alveolar macrophages in patients with COPD. Research has demonstrated that liposomal drug delivery systems, like those containing ciprofloxacin or dexamethasone, are useful in treating respiratory infections and diseases like acute respiratory distress syndrome (ARDS), with better treatment outcomes and fewer side effects (17).

In a study, the efficacy of agarwood essential oil (Agarwood-NE) was evaluated using a lab model of COPD using a unique nanoemulsion derived from poloxamer 407. Human lung cells were treated with 5% cigarette smoke extract to develop this model. According to the study, Agarwood-NE inhibited inflammatory chemicals such as IL-8, GDF-15, IL-1β, and IL-1alpha and stimulated the synthesis of anti-inflammatory chemicals such as GH, IL-10, and VDBP, hence reducing inflammation in the cells exposed to cigarette smoke. The study also demonstrated that Agarwood-NE could promote lung lining recovery and shield lung tissue from harm brought on by cigarette smoke. As a result, agarwood oil extract nanoemulsion seems to be a viable treatment for COPD (18).

A report on the preventive effects of berberine-containing liquid crystalline nanoparticles (NPs) based on phytantriol on oxidative stress and inflammation brought on by cigarette smoke in human bronchial cells is also available. According to the study, berberine's bioavailability was enhanced by employing NPs to distribute it, which led to a greater biological activity. Interestingly, the same therapeutic effect as a higher dose of free berberine could be obtained with a considerably lower amount of NP-loaded berberine. This lends credence to the theory that natural products with difficult physiochemical qualities can be delivered more successfully when using nanoparticle-based methods (19).

It has been highlighted that to optimize the efficacy and finally eradicate the disease, the novel treatments for COPD must be targeted precisely at the particular biological pathways or endotypes that give rise to the disease. Comprehending the variations in the inflammatory profiles linked to COPD may result in customized therapies by identifying new and improved therapeutic approaches for the management of the illness. Consequently, a multitude of clinical trials are underway to assess the efficaciousness of novel compounds like Phosphodiesterase Inhibitors, chemokine receptor (CXCR2) Antagonists, p38 Mitogen-Activated Protein Kinase Inhibitors, Phosphoinositide 3-Kinase Inhibitors etc. that selectively target the inflammatory process in the treatment of various subpopulations affected by COPD (20).

5. Conclusion

In summary, chronic obstructive pulmonary disease, or COPD, is a common and avoidable illness that is marked by deteriorating breathing problems and is linked to serious health problems, particularly in the elderly. The two main conditions, chronic bronchitis and emphysema, cause serious lung damage and ongoing inflammation. Pharmacokinetics, comorbidities, and age-related changes must all be taken into consideration while managing COPD in elderly individuals. Medication such as beta2-agonists, antimuscarinic drugs, and inhaled corticosteroids are effective forms of treatment, although therapy adherence is still quite difficult. Promising developments in the management of COPD include the use of personalized inhaler devices, novel therapies, and the promise of nanomedicine. Sustained investigation and focused strategies are necessary to enhance results and enhance the standard of living for those with COPD.

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